FLOOD HAZARD ANALYSES

SALZER - COAL CREEKS

LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

USDA-SCS-PORTLAND, OREG. 1975

WASHINGTON DEPARTMENT OF ECOLOGY
LEWIS COUNTY
LEWIS COUNTY CONSERVATION DISTRICT
CENTRALIA AND CHEHALIS

MAY 1975

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Salzer - Coal Creeks

Lewis County, Wash.

Prepared by

THE SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
SPOKANE, WASHINGTON

In Cooperation with

LEWIS COUNTY CONSERVATION DISTRICT
LEWIS COUNTY
WASHINGTON DEPARTMENT OF ECOLOGY
and
The Cities of
CENTRALIA and CHEHALIS

ACKNOWLEDGMENTS

The cooperation and assistance given by the many agencies, organizations, and individuals during this Flood Hazard Analyses Study is greatly appreciated. These include:

Lewis County Soil and Water Conservation District
Lewis County Commissioners
Lewis County Regional Planning Staff
Lewis County Engineer
Chehalis City Engineering Department
Centralia City Engineering Department
Washington State Department of Ecology
U.S. Corps of Engineers, Department of the Army
U.S. Geological Survey, Department of the Interior

Appreciation is also extended to the many individuals who contributed information for the study, and especially the landowners who permitted access to their properties for field surveys, photographs, and interviews.

PREFACE

Western Washington topography is generally mountainous, interlaced with rapid moving streams with relatively narrow flood plains. These flood plains are flat, accessible, and homes, factories, roads, and railways can easily be built on them. Also, people like to build near a good water supply or a pleasant, babbling brook. Thus, it is easy to understand the "good reasons" why people occupy the flood plains.

Occasionally high runoff causes these streams to swell and cover the flood plains. Severe erosion, property damage, or loss of life often result. However, people tend to dismiss floods as unusual, somewhat unreal, occasional events that have little to do with their daily lives. Yet today floods cost our nation over $1 billion a year (Steven H. Hanke, 1972). Can these losses be curtailed?

The first organized approach to this problem came in 1936 when Congress passed the Flood Control Act. This Act marked the beginning of a systematic governmental effort to reduce flood losses by structural control (dams, canals, dikes). However, as time progressed, it has been evident that this approach is only partially satisfactory. Frequently, after an area has been protected by structures, the land use will shift to more intense urban or industrial uses. These uses, then, depend upon the structural control for safety, and there is no guarantee that future events will not exceed the design flow criteria and do extensive damage.

The reduction of flood losses and the wise use of flood plains are the principal objectives of a "flood plain management program." Such a program includes nonstructural (i.e., insurance, zoning, building codes, open spaces, etc.) as well as structural control. No single solution can be applied to all flooding situations. Careful study of the flood hazard, with decision-making by responsible elected officials and alert citizens in an active "Flood Plain Management" program, offers the most practical solution to flood problems. This study is offered to the people of Lewis County, Washington, to help define a portion of their flood problem.

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Chapter 1

INTRODUCTION

The Request for the Flood Hazard Analyses Study

On May 1, 1973, the Lewis County Commissioners requested that a Flood Hazard Analyses be conducted on the lower Salzer-Coal Creek area. The study request was approved by the Washington State Department of Ecology, and forwarded to the Soil Conservation Service (SCS), USDA, on May 22, 1973. The final Plan of Study was signed July 13, 1973, by Lewis County, the cities of Centralia and Chehalis, the Washington Department of Ecology and the SCS.

The Authority for the Flood Hazard Analyses Study

Flood hazard analyses are carried out by the SCS as an outgrowth of the recommendations in A Report by the Task Force on Federal Flood Control Policy, House Document No. 465 (89th Congress; ordered printed August 10, 1966), especially recommendation 9(c), "Regulation of Land Use," which recommended the preparation of preliminary reports for guidance in areas where assistance is needed before a full flood-hazard information report can be prepared or when a full report is not scheduled.

The authority for funding flood hazard analyses is Section 6 of Public Law 83-566, the Watershed Protection and Flood Prevention Act, which authorizes USDA to cooperate with other federal and with state and local agencies to make investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of

coordinated programs. Funds for cooperative flood hazard studies are included in the USDA-SCS appropriation for river basin surveys and investigations.

In carrying out flood hazard analyses, SCS is responding to Executive Order 11296, dated August 10, 1966, especially to Section 1(4), which directs "all executive agencies responsible for programs which entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved."

USDA Secretary's Memorandums No. 1606 and 1607 (November 7, 1966), both dealing with the problem of managing flood losses, assigned to the Soil Conservation Service the leadership within the Department for implementing the applicable recommendations of House Document No. 465, as well as for representing the Department under Executive Order 11296.

The priorities regarding the location and extent of such studies in Washington are established by the Washington Department of Ecology in accordance with the April 1973 Joint Coordination Agreement with the SCS.

The Purpose of the Study

The purpose of this technical study is to provide flood hazard and other related information to the involved local governments and residents of the study area. This study provides flood frequencies, boundaries, profiles, and encroachment information. Also, in the development of this study, the SCS has constructed a computer model runoff

simulation of the Salzer-Coal Creek watersheds. This model and the study provide information which can assist state and local planners and officials in making wise land-use decisions regarding these flood plains.

CHAPTER 2

THE FLOOD PROBLEM

The Watershed

The Salzer-Coal Creek watershed is located in southwestern Washington in Lewis County (see the location map, figure 1). Salzer and Coal Creeks drain 24.5 square miles of relatively steep terrain, carrying alluvium to the Chehalis River on the Puget-Willamette lowland. The topography in the watershed ranges from 170 feet mean sea level at the outlet to near 800 feet mean sea level at the upper reaches.

The Climate

The Salzer-Coal Creek watershed has mild, rainy winters and warm, dry summers. The annual precipitation at Centralia is 45 inches, usually with a maximum near 10 inches per month from November through January. Annual snowfall for the region averages near 13 inches, but the snow rarely persists on the ground for more than three days. The mean temperature at Centralia ranges from 39° F. in January to 65° F. in July. The extreme temperatures recorded have been -16° F. and 105° F., but temperatures less than 15° F. or greater than 95° F. are rare.

The Extent of the Study

The computer model of the Salzer-Coal Creek watershed has been accomplished on the entire drainage area. Information on this computer model may be acquired from the Chehalis Soil Conservation Service office.

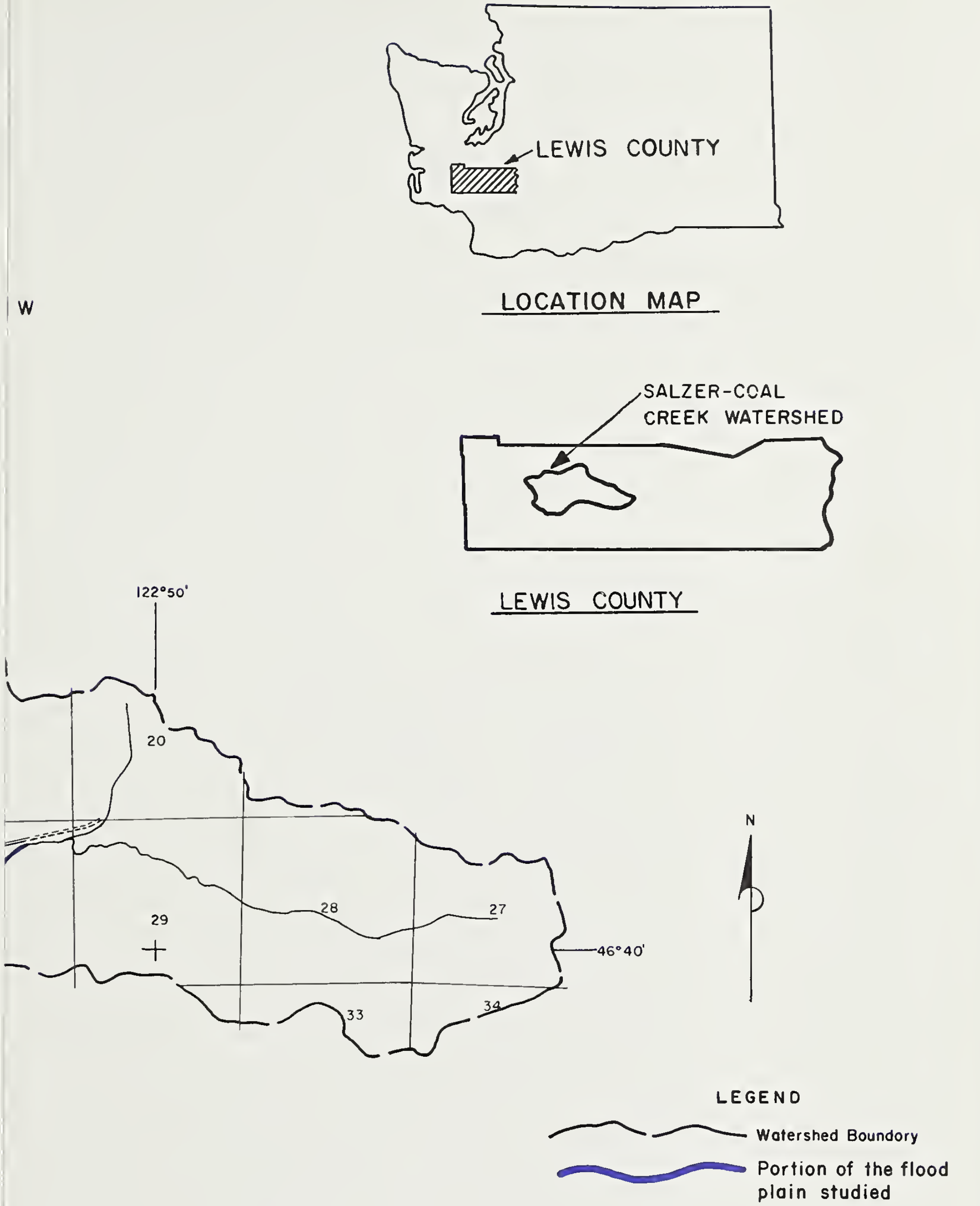


FIGURE I
FLOOD HAZARD ANALYSIS
SALZER-COAL CREEK
WATERSHED
LEWIS COUNTY, WASHINGTON

SCALE 1:63,360

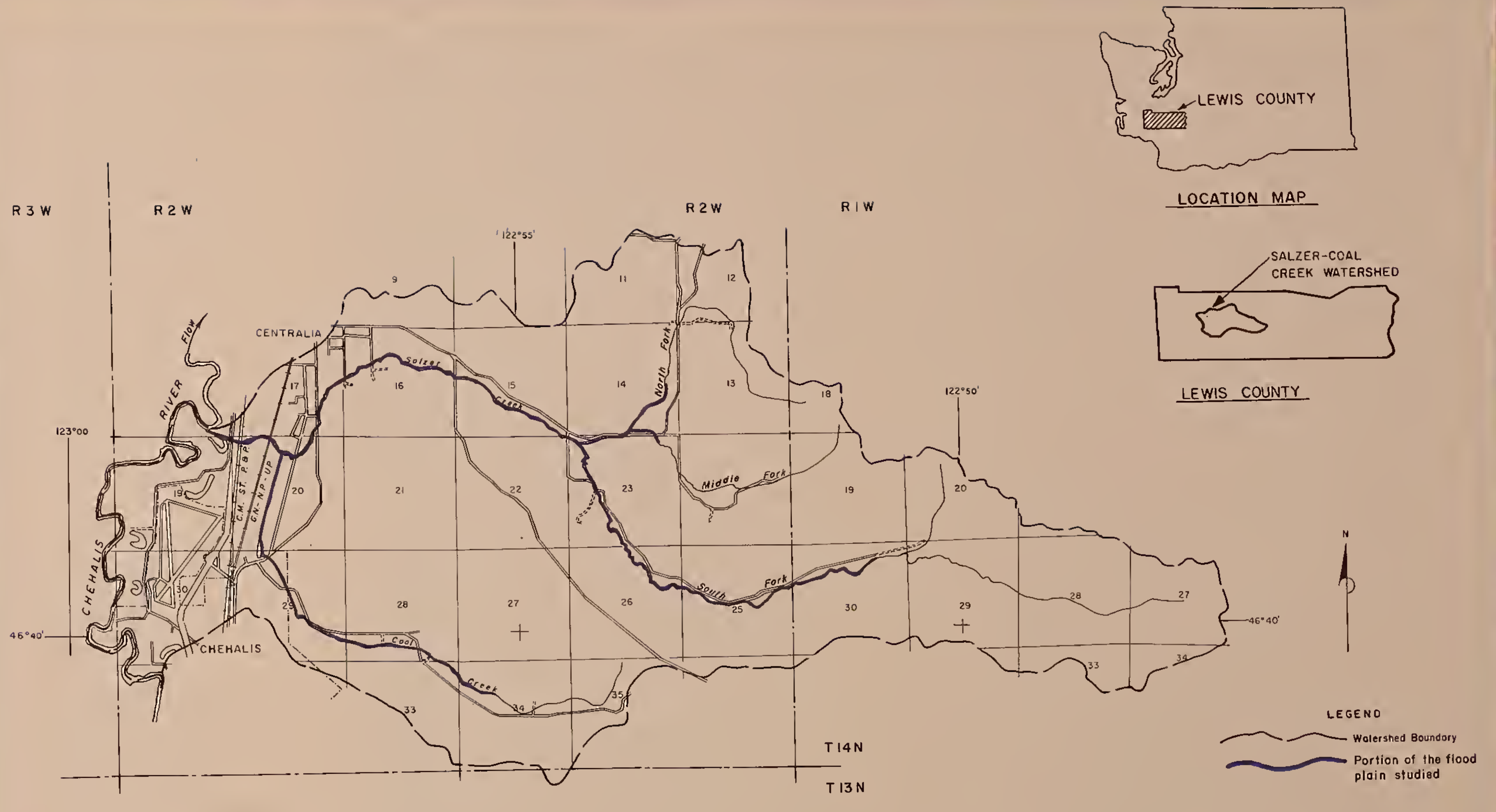


FIGURE 1
FLOOD HAZARD ANALYSIS
SALZER-COAL CREEK
WATERSHED
LEWIS COUNTY, WASHINGTON

USDA, Soil Conservation Service
360 U.S. Courthouse
Spokane, Washington 99201

USDA-SCS-PORTLAND OREG. 1975

The study area covered by this report begins on the North Fork of Salzer Creek in the northeast quarter of Section 14, Township 14 N., Range 2 W., and extends to the confluence with the Middle Fork. On the Middle Fork, the study begins at the section line between Sections 23 and 24 and continues downstream to the confluence with the South Fork. On the South Fork, the study begins just below the section line between Sections 29 and 30, Township 14 N., Range 1 W., and continues to the confluence with Coal Creek. On Coal Creek, the study starts at the center of Section 34, Township 14 N., Range 2 W., and continues downstream to the confluence with Salzer Creek and the Chehalis River (see the location map). This represents approximately eight miles of flood hazard analyses on the Salzer Creek and three miles on Coal Creek.

Past Flooding

Storms which cause flooding in the Salzer-Coal Creek watershed are usually associated with long steady rains (i.e., winter maritime occluded frontal systems) which are typified by longer duration, more uniform intensity, and more evenly distributed precipitation than the unstable shower (convective) storms. With this type of rainstorm, the flooding in one basin such as the Salzer will be associated with flooding on adjacent basins; thus, the rare occurrence of a 100-year frequency flood on the Salzer would be associated with high backwater of the Chehalis River.

Since there is little stream gage data on Salzer Creek (1968-1970) past flooding is assumed to occur when there is flooding on the Chehalis River, as explained above. The largest historical floods since 1929 on the Chehalis River at Grand Mound, Washington (USGS data) five miles downstream from the confluence with Salzer Creek are:

January 21, 1972	-	49,200 cfs
December 29, 1937	-	48,400 cfs
December 21, 1933	-	45,700 cfs
January 26, 1971	-	40,800 cfs
January 23, 1935	-	38,000 cfs
February 10, 1951	-	38,000 cfs
January 16, 1974	-	37,600 cfs

The U.S. Geological Survey Water Supply Paper 1687 computation equations give 48,900 cfs as the 50-year event for the Chehalis River at Grand Mound.

Figures 2 through 9 are photographs of past flooding on Salzer and Coal Creeks. Figures 2 through 5 illustrate the flood conditions in the January 26, 1971 flood. They begin near the outlet of Salzer and progress upstream. Notice the large expanse of water held in storage during flood stages. Figures 6 through 9 show flooding conditions existing during the January 16, 1974 high water. Although the peak flow on January 16, 1974, was about 10 percent less than the 1971 flood and 25 percent less than the 1972 flood, the flooding was significant. The flooding on Salzer-Coal at that time was used as the calibration flood for the model described in Chapter 3.

Figure 2. Flooding of portions of Centralia and Chehalis on Salzer and Coal Creeks near the confluence with the Chehalis River on January 26, 1971. DAILY CHRONICLE PHOTO

Figure 3. A close-up of the fairgrounds with Salzer Creek in the background in the January 26, 1971 flood. DAILY CHRONICLE PHOTO

Figure 4. Looking east up Salzer Creek valley from Grand Avenue in the foreground to the Centralia Alpha Road in the background.
DAILY CHRONICLE PHOTO

Figure 5. Looking east up the Salzer Creek valley with Centralia Alpha Road in the background and Salzer Creek Road on the left.
DAILY CHRONICLE PHOTO

Figure 6. Looking south across the confluence of Salzer Creek with backwater from the Chehalis River near the Al Hamilton farm, on January 16, 1974.

Figure 7. Looking south across Salzer Creek on January 16, 1974, along Grand Avenue near the bus station. Notice that automobiles are driving through water over the roadway.

Figure 8. Salzer Creek backwater on January 16, 1974, creating a flooding problem for Prairie Market (Centralia).

Figure 9. Looking south from the Salzer Creek Road across Salzer Creek at flood stage January 16, 1974.

Figure 10. Homes being inundared by floodwaters of the Chehalis River in the January 16, 1974 flood.

DAILY CHRONICLE PHOTO

Figure 11. Floodwater on Coal Creek near the "Old Yard Birds Store" in the January 21, 1972 storm (Chehalis).

Flooding Problems

As the level of the water in a stream or river increases and spreads over the surrounding flood plain, it usually does not cause damage until it inundates works of man. Man has constructed homes, farms, and roads, and has developed industry in the flood plain, usually without regard to the flood hazard involved.

Homes and industry are especially susceptible to extensive damages from high water. Figure 10 shows homes being inundated by high water on the Chehalis River. As the depth of water in a home increases to 2 feet, 30 percent of the value of the home is lost and 55 percent of the contents value is lost. At 4 feet deep, 50 percent of the value of the home is lost and 86 percent of the value of the contents. Thus, as the level of the water in a home increases from 0 to 4 feet, damages increase very rapidly (R. L. Albrook Hydraulic Laboratory, 1973; TSC-PO-4, 1971). This tends to be true of industry, also. Figure 11 shows the inundation near the Old Yard Birds Store during high water. Floating wooden shelving and racks were unstable during this high water and dumped merchandise into the water. In many industrial locations, high water will damage electrical systems, gearing systems, and bearing surfaces. Industry also may provide substantial quantities of floatable debris.

Present trends for flood protection of a home or industry built on the Salzer-Coal Creek flood plain are to require land fills on the flood plains to the level of an infrequent flood event (i.e., 100-year-frequency flood). Figure 12 shows filling for industrial sites

near the confluence of Salzer and Coal Creeks. This practice not only destroys wildlife and migratory bird habitat, but reduces water storage areas and causes higher flood elevations in future floods. The elevation of future floods depends upon the level of the Chehalis River at the peak discharge on Salzer-Coal Creek, the amount of land fill, the physical arrangement or layout of the land fill, and the hydraulic conditions in the channel. The effects of various combinations of these conditions may be studied by the model described in Chapter 3.

Dr. Howard Copp, R. L. Albrook Hydraulic Laboratory, Washington State University, documented, for the Washington State Department of Ecology, the dangers of mobile homes on flood plains. The film showed that during high water a trailer home may float and be carried downstream until it lodges against some debris blockage. These debris blockages commonly occur at constrictions in the flow, such as bridges. Professor Copp stresses that the structural stability of a mobile home is not great enough to withstand the stresses that can be produced during a flood. Mobile homes are commonly torn apart by floodwaters and offer little safety for the occupants. Figure 13 shows a local trailer during the 1974 high water on the Chehalis River.

Figure 12. Filling of flood plains for industrial development near the lower reaches of Coal Creek January 16, 1974 flood.

Figure 13. A trailer house near Chehalis during the January 16, 1974 flood on the Chehalis River.

Figure 14. An automobile passing along a submerged roadway near Chehalis during the January 16, 1974 flood on the Chehalis River.

Figure 15. Hampe road used as a dike between Grand and National Avenues near the lower Salzer Creek during the January 16, 1974 flood.

For homes and industry located in the flood plains, floodproofing can be utilized. Floodproofing consists of adjustments to structures, such as ceiling-based electrical systems, pressure sealing doors, or elevated buildings, which are designed primarily to reduce flood damages. Such adjustments can be scheduled to be undertaken in existing buildings during remodeling or expansion. Also, they can be incorporated into new buildings during initial construction if such buildings would constitute a proper land use of a flood plain.

Roads also provide problems during flood stages. Figure 14 shows a local automobile passing along a submerged road. Notice that it is difficult to judge where the roadway is. The dangers of washed-out bridges also exist. Under complete submersion, roads suffer little physical damage if the water velocities are low. However, if roads become dikes as shown in Figure 15 and are finally overtopped, excessive damage can result. High water velocities build up as the water pours over the roadway to the lower elevation behind the road. Turbulent eddies in these high velocity scour areas cause soil and rock dislodgment and severe undermining.

The top photograph in Figure 16 shows the results of such erosion. There are approved methods to protect roads against scour by floodwater; however, they increase the cost of road construction.

Figure 16 shows other examples of serious erosion from high flows. Increased water velocities dislodge vegetation, soil and rocks, leaving even massive bridge structures useless until repairs can be completed.

The lower picture in Figure 16 shows the danger of home construction on an outside curve of an unstable river.

Sewage disposal plants located in the flood plain also offer problems. Figure 17 shows the Chehalis sewage plant during the 1974 high water. During high flows, floodwater may exceed the height of a plant's dike system and treatment basins. This would render the treatment useless and raw effluent would be swept into the floodwater, increasing the danger of sickness and disease downstream. Also, the floodwater, sediment and debris can cause extensive (i.e., expensive) damage to the sewage plant.

The Great Flood Problem

The tremendous annual expense for flood damages on man's structures placed on the flood plain is the result of man's attitude toward flood plain development. All too frequently, knowledge of a specific flood hazard area is gained by experience. However, people's memories become quickly dimmed by the passing of time, and the next flood catches the area as unprepared as the previous flood did.

The Department of Housing and Urban Development's Federal Insurance Administrator prepared a Congressional report (Bernstein, 1974) on the flood damage hazard in the United States. A major conclusion of the report was "that many people in high flood risk areas are seriously uninformed about the risk of flooding to which they are exposed, or that they are grossly over-optimistic about the chances that their property will not be flooded, or else that they expect public help to bail them out when the inevitable flood disaster strikes."

Figure 16. Examples of road and house destruction due to high water. 16 A County highway near Mineral, Washington, January 16, 1974. 16 B County highway bridge near Mineral, Washington, January 16, 1974. 16 C House on highway 508 near Anderson Corner, January 26, 1971.

Figure 17. The Chehalis Sewage Treatment Plant and surrounding area during the January 16, 1974 Flood on the Chehalis River.

CHAPTER 3

DATA SOURCES AND ANALYSES METHODS

Data Sources

The basic data used in this study include U.S. Geological Survey (USGS) topographic maps, bench marks, and streamflow records, both inside and outside the watershed. Survey bench mark information was also provided by the Washington State Department of Highways and the city of Centralia. The U.S. Army Corps of Engineers, Seattle District Office, provided the elevation of the confluence of the Chehalis River and the Salzer Creek for the 100-year event and aerial photographs of the 1971 flood on the Chehalis River. The Chehalis-Centralia Daily Chronicle provided aerial photographs of the Salzer-Coal Creeks and the Chehalis River during the 1974 and 1971 floods.

High water marks and damage estimates were provided by numerous landowners to the SCS field crews. SCS survey crews secured valley cross section information approximately every 800 feet and additional bridge and culvert information. SCS hydrologists provided flow characteristics for the modeling and SCS soil scientists from Chehalis provided the hydrologic soils groupings for the model. Also, SCS purchased 1972 aerial photographs from the Washington Department of Natural Resources for stereoscopic interpretations of land use and vegetative cover information.

Analyses Methods

The SCS developed a computer model for the Salzer-Coal Creek

watershed. One portion of the simulation (TR-20) predicts the peak flow at specific locations, based on rainfall data, land use, soil type, topography and uses unit hydrograph techniques. This portion of the model was calibrated with a regional Log-Pearson Type III frequency analysis of USGS streamflow data on Klickitat Creek, Lincoln Creek, the Newaukum River, Winston Creek and the Chehalis River. This analysis agreed with the results of the USGS Water Supply Paper 1689.

The second portion of the SCS model (WSP-2) forecasts the backwater of the Salzer-Coal Creek based on the physical characteristics of the channel, bridges, and overbank flow. High water marks established during the 1974 storm were used to check the resulting water surface profiles. These water surface profile elevation-discharge relationships were used to establish flood elevation for the various events at each of the surveyed cross sections. Flood lines were located between valley cross sections by stereoscopic interpretations, field flood plain mapping, and historical records of high water marks.

Water surface profile computations at bridges are based on present normal bridge openings. Consideration was not given to possible blockage of the openings by sediment or debris, nor was consideration given to any future enlargement. Presently, several bridges in the study area lack the capacity to convey the 100-year flow, or have restrictions (i.e., pipes, cables) which would tend to collect debris during high flows. An example is the Coal Creek bridge on

Figure 18. Elevation of 100-year frequency event in front of Yard Birds Shopping Center (Chehalis) in the Coal Creek flood plain.

Figure 19. Elevation of 100-year frequency event in front of M & R Sales, near Albertson's Grocery (Centralia) in the Salzer Creek flood plain.

National Avenue with a water main, sewer main, and gas main below the bridge clogging the channel.

The first two portions of the SCS computer model were used to simulate the 2-, 5-, 10-, 25-, 50-, 100- and 500-year frequency flood events. However, only the 100-year event has been delineated on the aerial photomaps, profiles and typical cross sections. If more complete information is needed, profiles of all of the above frequency events have been provided to the Lewis County Engineer and the Chehalis Soil Conservation Service office.

The third portion of the SCS model (HUD-15) provides changes in the water surface profiles due to filling or other encroachments in the flood plain. When encroachment causes a change in the water surface profiles of more than 1 foot, this marks the limit of the floodway fringe and no further encroachments should be allowed without serious consideration of the dangers involved. If the designated floodway is narrowed, adequate structural flood control measures should be required. Narrowing the floodwater flowage and storage capacity of the flood plains will increase flood depths and velocities, increasing potential damages to existing and future properties within the flood plain.

The Washington State Department of Ecology and the SCS will, upon request, provide technical assistance to federal, state, or local agencies and organizations in the interpretation of information developed in this study.

CHAPTER 4

RESULTS OF THE ANALYSIS

Flood Potential under Present Land Use

This study developed the necessary information to show those portions of the Salzer-Coal Creek flood plain subject to inundation by a 100-year flood (see the following photomaps, plates 2 through 5). The data developed was based on watershed cover, flood plain use, and channel conditions existing in July-October 1973. This information was supplemented by high water information gathered during the January 14-16, 1974 flood. However, no attempt was made to include other changes, fills or dikes constructed after October 1973. The delineated areas subject to inundation, as shown in plates 2 through 5, are general and may include small areas that do not flood, or vice versa.

Tables 1 and 2 in Appendix B show the estimated peak discharge and the water surface elevation of select frequency floods at specific locations in the study area. Following Tables 1 and 2 are plates 6 through 23 which show the 100-year flood profile and typical valley cross sections for Salzer and Coal Creeks.

To estimate the 100-year floodwater elevation at a specific location, refer to the aerial photomap and determine where the location is relative to the nearest upstream and downstream surveyed cross sections. Next, check the elevation of the surveyed cross sections in Table 2. For locations between surveyed cross sections, it is necessary to interpolate to determine the estimated water surface elevation.

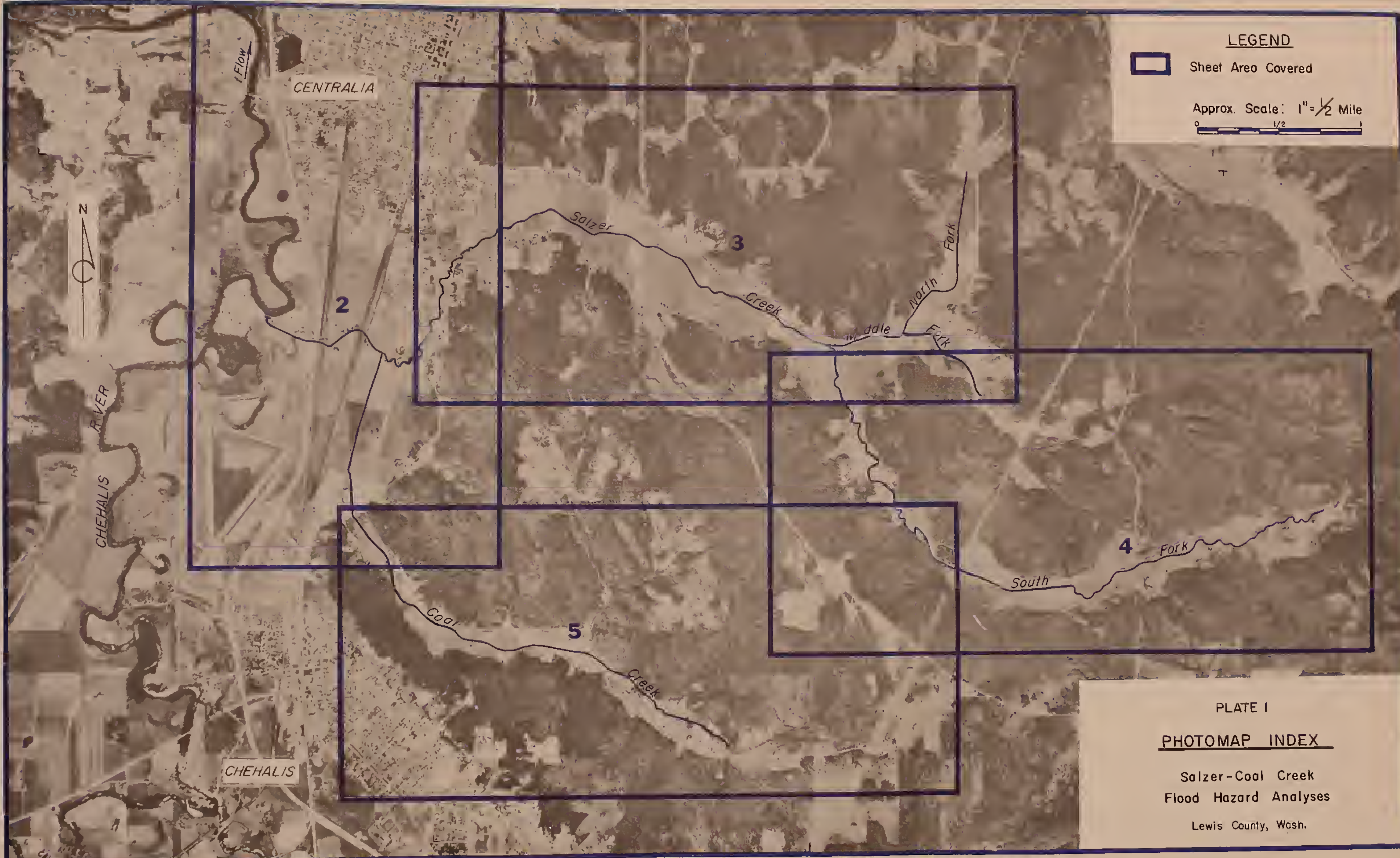


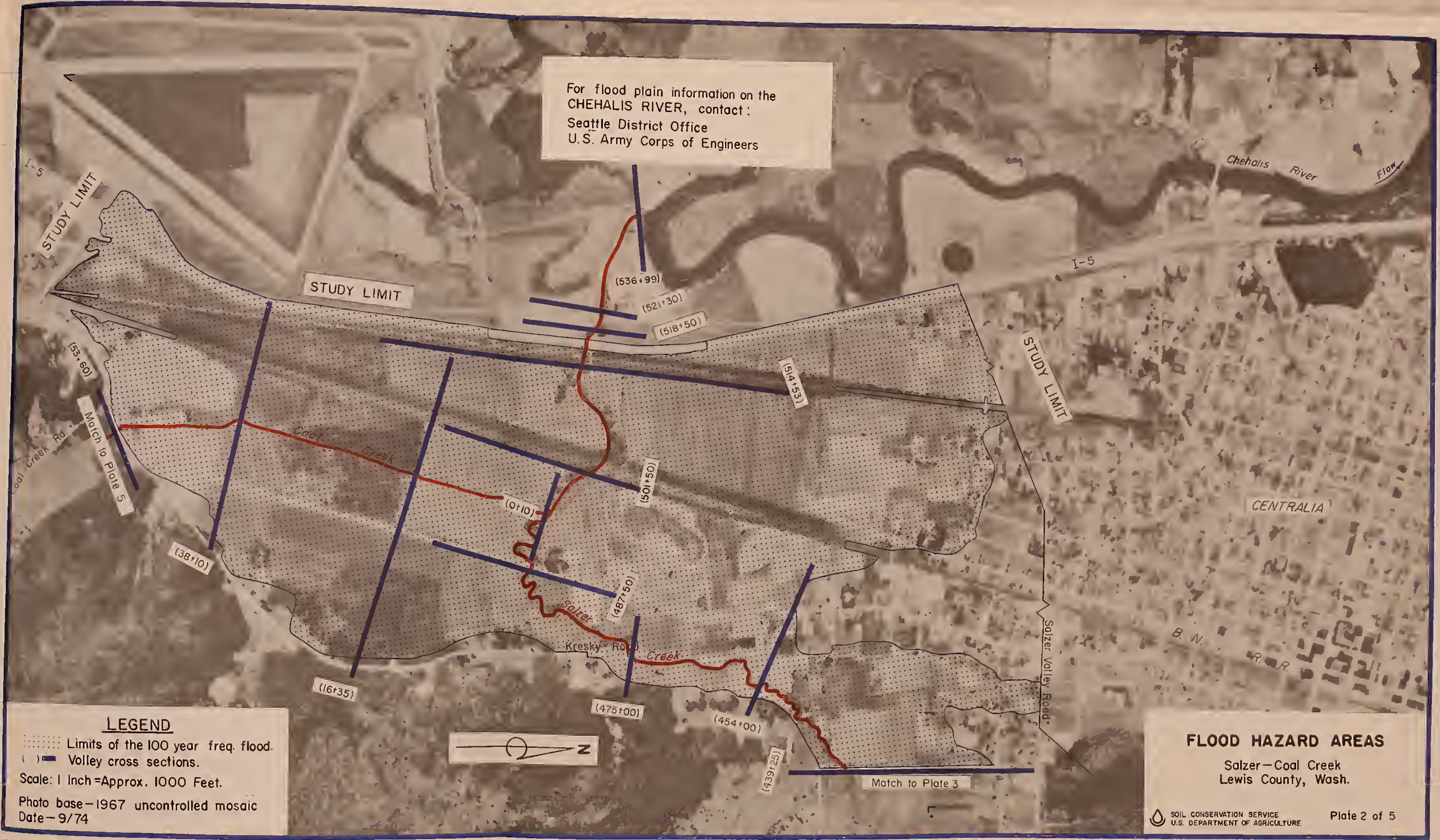
PLATE I

PHOTOMAP INDEX

Salzer-Coal Creek
Flood Hazard Analyses

Lewis County, Wash.

USDA-SCS – SPOKANE, WASH USDA-SCS-PORTLAND, OREG. 1975



USDA-SCS-PORTLAND, OREG. 1975

USDA-SCS-PORTLAND, OREG. 1975

Proffitt Road
Match to Plate 3
(293+56)
(286+00)
(270+00)
(248+00)
(237+65)
(220+69)
(204+00)
(179+83)
(162+00)
(135+00)
STUDY LIMIT
N
Centralia Alpha Road
South Fork Salzer Creek
LEGEND
Limits of the 100 year freq. flood.
Valley cross sections.
Scale: 1 Inch = Approx. 1000 Feet.
Photo base - 1967 uncontrolled mosaic
Date - 9/74
FLOOD HAZARD AREAS
Salzer - Coal Creek
Lewis County, Wash.
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
Plate 4 of 5

(53+60)
Match to Plate 2
(71+40)
(95+25)
(110+70)
(143+60)
(159+40)
(172+75)
(195+75)
Coal Creek Road
Coal
Creek
STUDY LIMIT
STUDY LIMIT
Centralia Alpha Road
CHEHALIS
N
LEGEND
Limits of the 100 year freq. flood.
( ) Valley cross sections.
Scale: 1 inch = Approx. 1000 Feet.
Photo base – 1967 uncontrolled mosaic
Date – 9/74
FLOOD HAZARD AREAS
Salzer – Coal Creek
Lewis County, Wash.
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
Plate 5 of 5

Another method to determine a floodwater elevation at a specific location is to estimate the channel station near the location in question from the stations on the aerial photomap. Next, find the location of that station on the profile sheets. Read the flood elevation directly from the profile sheet by going vertically from the location station to the plotted floodwater line and then horizontally to read the elevation.

Plates 6, 7 and 8 show how the backwater effect of the Chehalis River dominates the flow of the Salzer Creek up to approximately the Pacific Avenue bridge at the 100-year event. On Coal Creek this influence, shown on Plate 18, continues upstream to about station 40+00. This is about 1,200 feet downstream from the National Avenue bridge. Also, Plates 18 and 20 show significant profile changes under the bridges crossing the streams. This is a good indication that the roads are acting as effective dams (i.e., the bridges lack the conveyance to pass the 100-year event) and impoundment areas exist upstream from each of these bridges. This is also shown on Plate 11 at station 293+56.

Table 3, Appendix B, shows the minimum floodway widths required, right and left of the stream, so that the water surface elevations will not rise more than 1 foot (under present natural flow conditions of the 100-year event). Small values on the right or left (looking downstream) would indicate higher ground, a dike, or a fill on that side of the stream. The minimum floodway width analysis was based on equal conveyance reductions on both sides of the stream, where possible.

Flood Potential under Future Land Use

Based upon Lewis Regional Planning Commission forecasts of the future development in the watershed, the computer model (TR-20 and WSP-2 described in Chapter 3) was programed to forecast future peak flows. Briefly, the model assumes intensive industrial or urban land use in the lowlands below Alvord Road on Salzer Creek and below the first crossing of the Coal Creek Road on Coal Creek. It was assumed there would be only slight changes of land use in the lowlands of the upper watershed. The highland area and the steep slopes of the watershed were assumed to be maintained in timber production. The channels were assumed to remain as unimproved channels with no changes in the present bridges or overland storage.

The results of the forecast changes in land use are provided in Appendix B, Tables 4 and 5. A comparison of Tables 1 and 2 with Tables 4 and 5 reflects the result of changes in land use. They show an 11 percent increase in peak flow for the 100-year event near the bus station; however, little changes in floodwater surface elevations. This is because the flood plains are wide, flat, and contain overland storage water. If the overland storage were reduced by encroachment and/or structural changes in the channel, large differences in the water surface profile could result.

The results of this study are presented as a base from which the county and cities may compare the effects of future alternatives for development.

The Soil Conservation Service ADP Model as a Planning Tool

The SCS computer model is calibrated and can be utilized to aid the local government officials and planners in their decision-making processes by providing the effects of alternative land uses, alternative structural changes to the streams, and the effects of encroachments on overland storage.

CHAPTER 5

RECOMMENDATIONS

The preceding section presents flood hazard data for the Salzer-Coal Creek study area. The area is presently being urbanized, which means new homes, new businesses, etc. This results in less vegetative cover to absorb precipitation and more rooftops, land fills, pavements and storm sewers. The result will be increasing rate and volume of runoff, causing increased flood hazards.

Most of the urbanization in the Salzer-Coal Creek area is on the flood plains. Associated with urbanization is increased property values. Owners and developers of these lands argue that severe land use restrictions on the flood plains "takes" the land. However, good flood plain management would suggest that the flood plains be left in agriculture, parks, open space, or other land uses which would not obstruct floodflows. Such spaces would allow floodwater to pass with a minimum of monetary damage to the community.

The differing objectives between the users of the flood plains and the managers of the flood plains are often best resolved by the two-zone (i.e., floodway and floodway fringe) approach to land use and development.

Under the two-zone approach, flood-protected and elevated construction would be allowed in the outer fringe of the flood plain, and severely restricted development in the inner floodway area. Homes or apartments and commercial buildings may be allowed in the fringe provided they are protected by adequate floodproofing. In the designated

floodway, more open space land uses compatible with periodic flooding (i.e., agriculture, golf courses, parking lots, etc.) should be permitted.

This report includes information on the delineation of the 100-year flood and the limits of the floodway fringe. This is necessary information to set up the two-zone approach for flood plain management. Users of the flood plain should base their use upon the advantages and disadvantages of locating within the flood hazard areas. Unfortunately, knowledge of the hazards involved is not widespread and laymen can seldom accurately assess the risks involved. Therefore, managers should utilize local planning programs to inform the local user and guide the developments in the flood plain.

It is suggested that the following nonstructural measures be considered as well as structural flood control measures for flood plain management:

Land Use Planning

Flood Plain Control Regulations

Flood Plain Development Policies

Flood Plain Filling Regulations

Flood Plain Acquisition

Flood Plain Zoning

Flood Warning System

Flood Insurance

Tax Adjustment

Health Regulations

Building Codes

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APPENDIX A

GLOSSARY OF TERMS

GLOSSARY OF TERMS

Channel - A natural or artificial water course of perceptible extent with definite bed and banks to confine and conduct continuously or periodically flowing water.

Encroachment - The act of advancing development into the flood plain beyond the flood hazard boundary.

Flood - An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: the inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water. Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflows, and other problems.

Flood Frequency - A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative streamflow or rainfall and runoff records. It is customary to estimate the frequency with which specific flood stages or discharges may be equalled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates by strict definition are designated "exceedence frequence," but in practice the term "frequency" is used. The frequency of a particular stage or discharge is usually expressed as occurring once in a specified number of years. Also see definition of "Recurrence interval."

10-year Flood - A flood having an average frequency of occurrence in the order of once in 10 years. It has a 10 percent chance of being equalled or exceeded in any given year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

100-year Flood - A flood having an average frequency of occurrence in the order of once in 100 years. It has a 1 percent chance of being equalled or exceeded in any given year. This flood is comparable to the "Intermediate Regional Flood" used by the U.S. Army Corps of Engineers. It is based on statistical

analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

Rare Flood - The flood that may be expected from a combination of meteorological and hydrological conditions that are considered extreme but reasonable for that geographical area, excluding extremely unlikely conditions. It may be considerably larger than any flood that has occurred in the watershed. However, an even larger and more severe flood can, and probably will, occur.

For the purpose of this study, it is considered to have an approximate average frequency of occurrence in the order of once in 500 years although the flood may occur in any given year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

Flood Peak - The highest stage or discharge attained during a flood event; also referred to as peak stage or peak discharge.

Flood Plain - The relatively flat area or lowlands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water, which has been or may be covered by floodwater.

Flood Profile - A graph showing the relationship of water surface elevation to stream channel location. It is generally drawn to show surface elevation for the peak of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage - The elevation of the overflow above the natural banks of a stream or body of water sometimes referred to as the elevation at which overflow begins.

Flood Storage - The difference in the volume of storage between the initial base flow elevation and the flood peak elevation, measured for a specific area.

Floodway - The channel of the stream and those portions of the flood plain which are required to carry and discharge floodwater of a 100-year event with no more than a 1.0 foot increase in water surface elevation due to encroachment.

Floodway Fringe - That area of the flood plain lying outside the floodway but within the flood plain. Without land fills, the area will be inundated by floodwater that provides backwater storage.

High Water Mark (HWM) - The maximum observed and recorded height or elevation that floodwater reached during a storm, usually associated with the flood peak. The high water mark may be referenced to a particular building, bridge or other landmark, or based on debris deposits on bridges, fences or other evidence of the flood.

Recurrence Interval - The average interval of time, based on a statistical analysis of actual or representative streamflow records, which can be expected to elapse between floods equal to or greater than a specified stage or discharge. Recurrence interval is generally expressed in years. Also see definition of "Flood Frequency."

Runoff - That part of precipitation, as well as any other flow contributions, which appears in surface streams of either perennial or intermittent form.

Stream Channel - A natural or artificial water course of perceptible extent, with definite bed and banks to confine and conduct continuously or periodically flowing water.

Stream Channel Bottom - The lowest part of the stream channel (either in a constructed cross section or a natural channel). Bottom elevations at a series of points along the length of a stream may be plotted and connected to provide a stream bottom profile.

Stream Channel Flow - That water which is flowing within the limits of a defined water course.

Watershed - A drainage basin or area which collects runoff and transmits it usually by means of streams and tributaries to the outlet of the basin.

Watershed Boundary - The divide separating one drainage basin from another.

Wetland - Areas where the water table is at or near the surface of the ground and the soil remains wet for more than seven months of each year. Wetlands include swamps, marshes and wet meadows.

APPENDIX B

TECHNICAL SUPPORT DATA

TABLE 1

FLOOD FREQUENCY DISCHARGE FOR SELECTED CROSS SECTIONS

WITH PRESENT LAND USE

Cross Section Station	10-Year CFS	50-Year CFS	100-Year CFS	500-Year CFS
		Estimated Peak Discharges for Selected Frequency Floods		
		SALZER CREEK		
536+99	600	1,070	1,360	2,000
475+00	470	830	1,060	1,600
420+50	430	760	970	1,400
363+00	400	700	900	1,300
320+11	370	670	850	1,200
		SOUTH FORK SALZER CREEK		
293+56	250	450	580	850
286+00	250	440	560	840
237+65	230	410	530	780
179+83	180	320	410	610
112+00	160	280	350	520
		MIDDLE FORK SALZER CREEK		
M 16+00	190	340	440	650
M 39+00	80	140	180	260
M 56+68	70	120	150	220
		NORTH FORK SALZER CREEK		
N 8+00	180	320	410	610
N 43+14	170	310	400	580
		COAL CREEK		
0+10	230	420	530	790
53+10	210	370	470	690
71+80	190	350	440	650
110+70	180	320	400	590
143+60	170	310	390	580
159+80	120	220	280	420
195+75	70	120	160	230
223+05	30	50	60	100

TABLE 2

ELEVATIONS OF VARIOUS FREQUENCY FLOODS

WITH PRESENT LAND USE

Channel Station	Streambed	10-Year Flood	50-Year Flood	100-Year Flood	500-Year Flood
	------------Elevation in Mean Sea Level------------				
		SALZER CREEK			
536+99	146.9	167.9	173.0	175.5	179.6
488+00	157.2	168.4	173.2	175.6	179.7
Bus Sta					
475+00	158.8	169.1	173.6	175.7	179.7
454+00	162.5	170.6	173.8	175.8	179.8
Pacific Avenue					
439+25	166.5	172.1	175.0	176.1	179.9
425+40	163.9	172.5	175.0	176.1	179.9
Alvord Road					
420+50	164.2	172.7	175.1	176.2	179.9
382+00	168.0	175.4	176.7	177.0	180.0
Centralia Alpha Road					
363+00	170.3	176.0	177.2	177.5	180.1
346+00	174.3	179.1	179.8	180.0	180.6
320+50	175.6	182.4	183.2	183.6	184.4
Proffitt Road					
320+11	176.3	182.5	183.3	183.6	186.0
		SOUTH FORK			
293+56	181.9	187.1	188.6	189.2	189.8
293+00	181.9	189.2	192.5	192.8	192.9
286+00	185.1	190.0	192.7	192.9	193.2
248+00	197.7	201.5	202.4	202.4	203.5
237+65	199.6	204.9	205.9	205.8	207.5
220+69	205.1	208.5	209.0	209.1	209.9
204+00	208.5	214.0	214.6	214.6	215.3
179+83	218.3	222.1	222.9	222.9	223.5
162+00	226.3	230.9	231.8	231.7	232.8
112+00	243.6	247.0	248.0	248.0	249.1
		MIDDLE FORK SALZER			
M 16+00	180.1	185.9	186.3	186.4	187.7
M 28+40	186.7	191.4	192.4	192.8	193.3
M 39+02	194.7	196.7	197.6	197.8	198.7
M 48+02	194.7	196.9	197.8	198.8	198.9

TABLE 2 (cont.)

ELEVATIONS OF VARIOUS FREQUENCY FLOODS

WITH PRESENT LAND USE

Channel Station	Streambed	10-Year Flood	50-Year Flood	100-Year Flood	500-Year Flood
	-------------Elevation in Mean Sea Level-------------				
		NORTH FORK SALZER			
N 8+00	177.8	193.0	194.8	195.0	195.0
N 30+19	198.8	202.8	203.3	203.4	203.8
N 43+14	206.9	210.2	211.0	211.4	212.0
		COAL CREEK			
0+10	156.6	168.1	173.1	175.5	179.6
52+10	165.0	170.4	174.0	175.9	179.7
National Avenue					
53+10	166.3	170.9	175.5	177.3	180.8
71+00	168.6	173.8	176.0	177.5	180.8
Coal Creek Road					
71+80	167.0	174.2	176.8	178.3	181.0
95+25	173.0	178.8	179.8	180.2	181.5
110+70	178.8	184.1	184.9	185.3	185.6
143+60	189.8	194.1	194.9	195.3	195.8
159+00	197.7	200.6	201.1	201.3	201.9
Coal Creek Road					
159+80	197.7	201.1	202.2	202.9	204.0
195+75	221.8	224.8	225.5	225.7	226.3
223+05	235.1	237.5	238.0	238.3	238.8

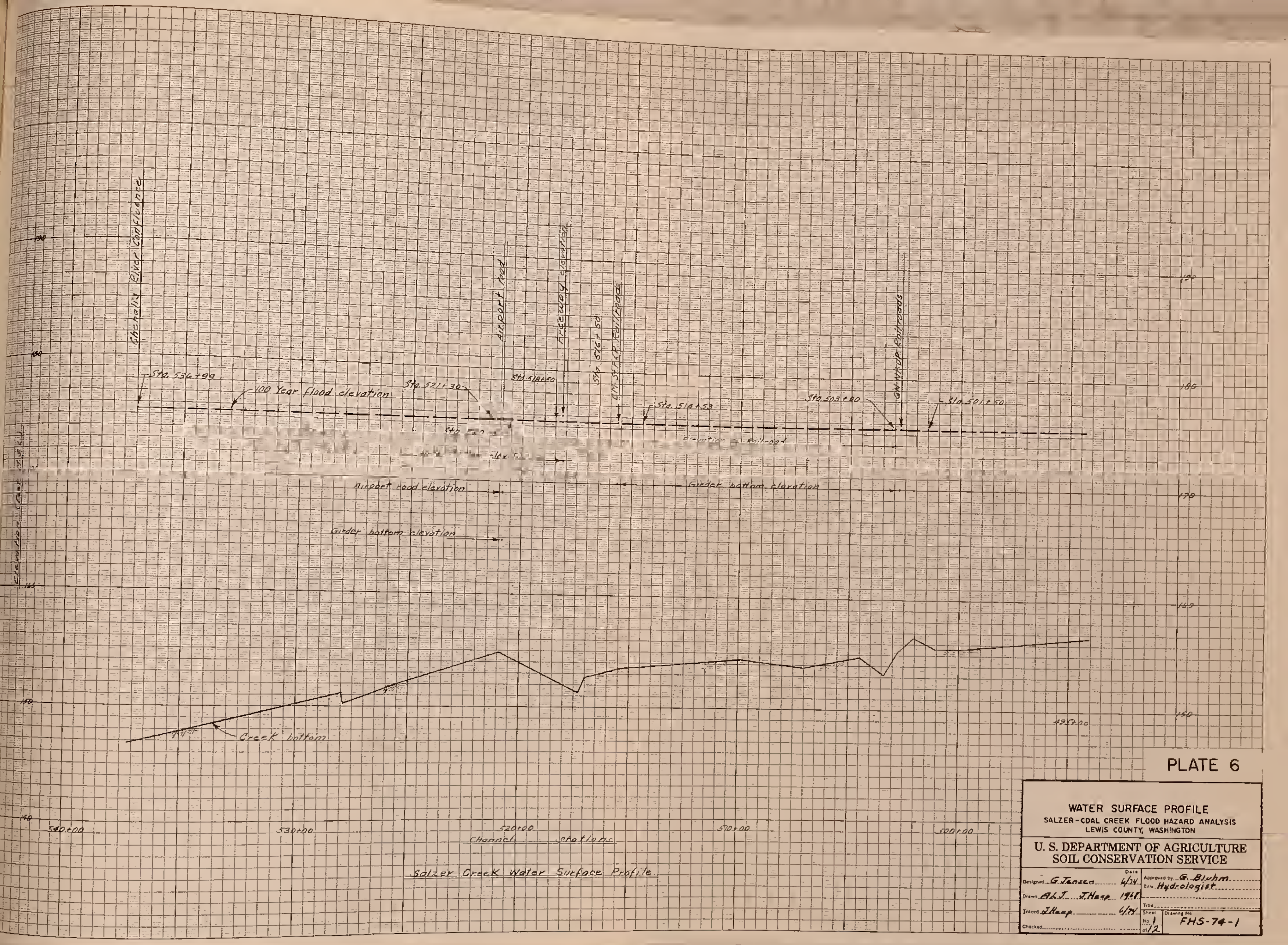
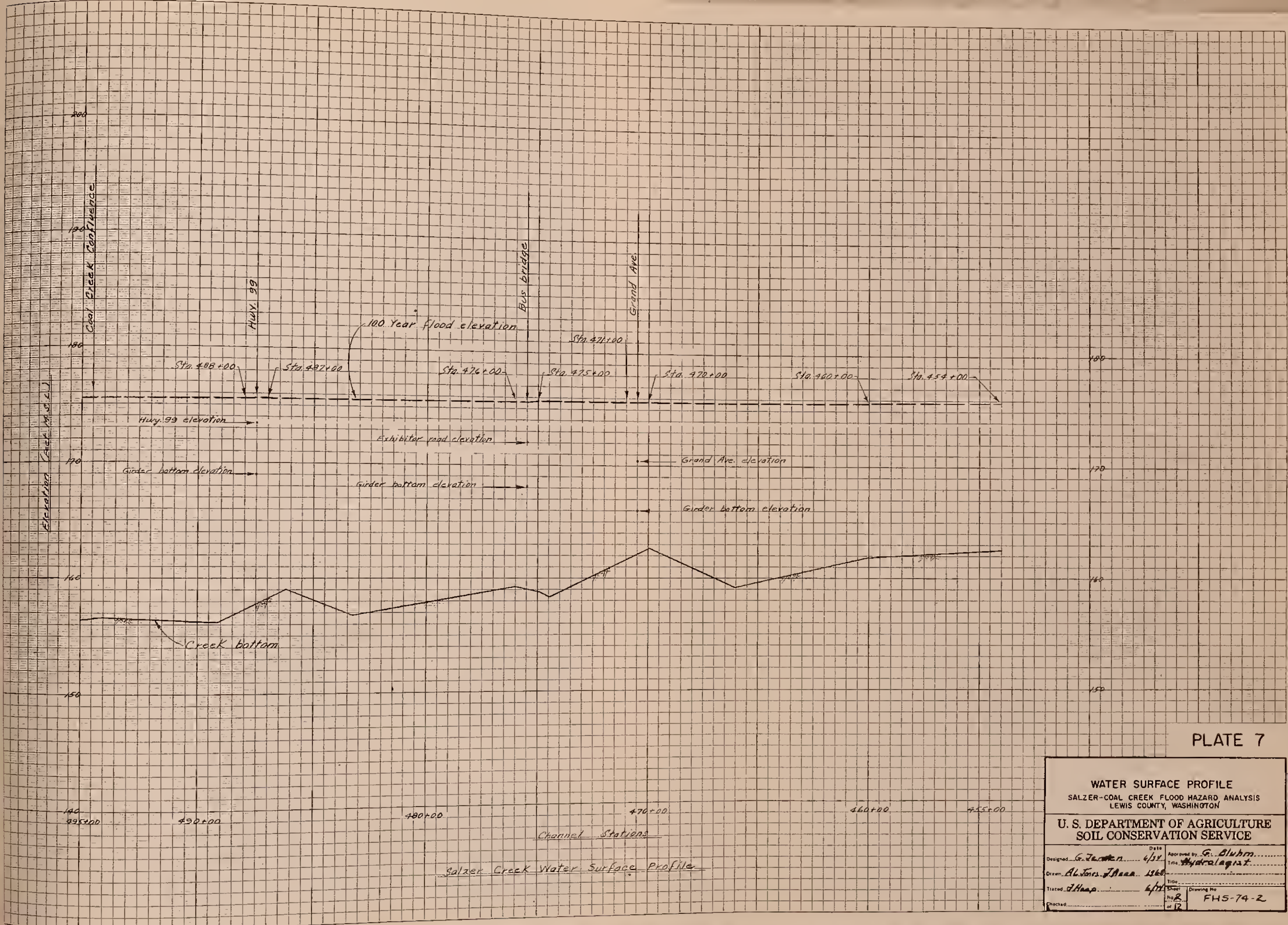


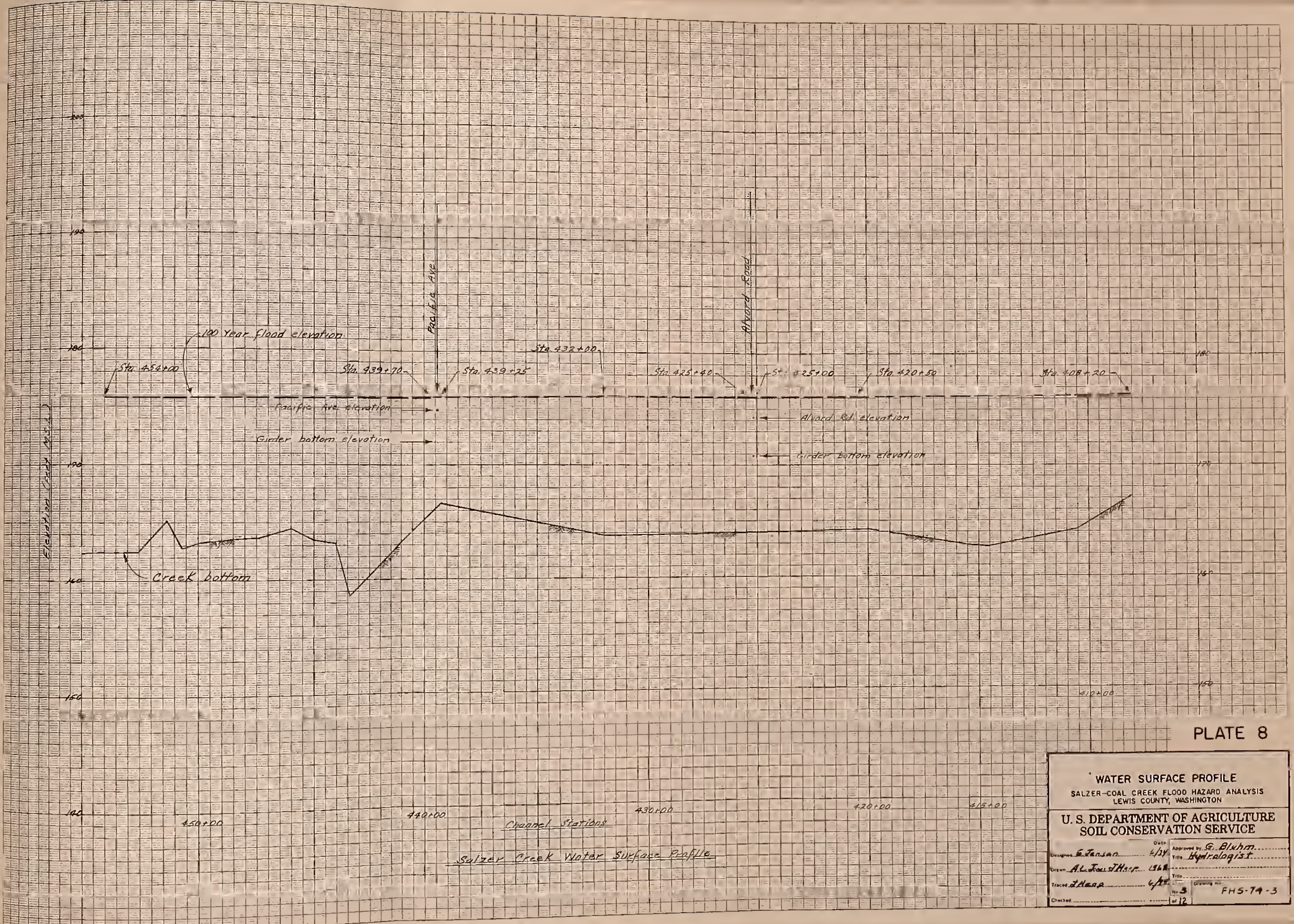
PLATE 6

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen 4/74 | Approved by G. Bluhm
Drawn ALJ J.Heap 1948 | Title Hydrologist
Traced J.Heap 4/74 | Title
Checked | Sheet No. 1 of 12 | Drawing No. FHS-74-1


Elevation (feet M.S.L.)
200
190
180
170
160
150
140
Coal Creek Confluence
Hwy. 99
Bus bridge
Grand Ave.
100 Year flood elevation
Sta. 488+00
Sta. 487+00
Sta. 476+00
Sta. 475+00
Sta. 471+00
Sta. 470+00
Sta. 460+00
Sta. 454+00
Hwy. 99 elevation
Exhibitor road elevation
Grand Ave. elevation
Girder bottom elevation
Girder bottom elevation
Girder bottom elevation
Creek bottom
495+00
490+00
480+00
470+00
460+00
455+00
Channel Stations
Salzer Creek Water Surface Profile
PLATE 7
WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Approved by G. Bluhm
Title Hydrologist
FHS-74-2



200
190
180
170
160
150
140
Elevation (feet M.S.L.)
100 Year flood elevation
Sta. 454+00
Sta. 439+70
Sta. 439+25
Sta. 432+00
Sta. 425+40
Sta. 425+00
Sta. 420+50
Sta. 408+20
Pacific Ave
Alvord Road
Pacific Ave elevation
Girder bottom elevation
Alvord Rd. elevation
Girder bottom elevation
Creek bottom
450+00
440+00
430+00
420+00
415+00
410+00
Channel Stations
Salzer Creek Water Surface Profile
WATER SURFACE PROFILE
SALZER–COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed G. Jensen 4/74
Drawn AL Ian J Harp 1968
Traced J Harp 6/74
Checked
Approved by G. Bluhm
Title Hydrologist
Sheet No. 3 of 12
Drawing No. FHS-74-3

PLATE 8

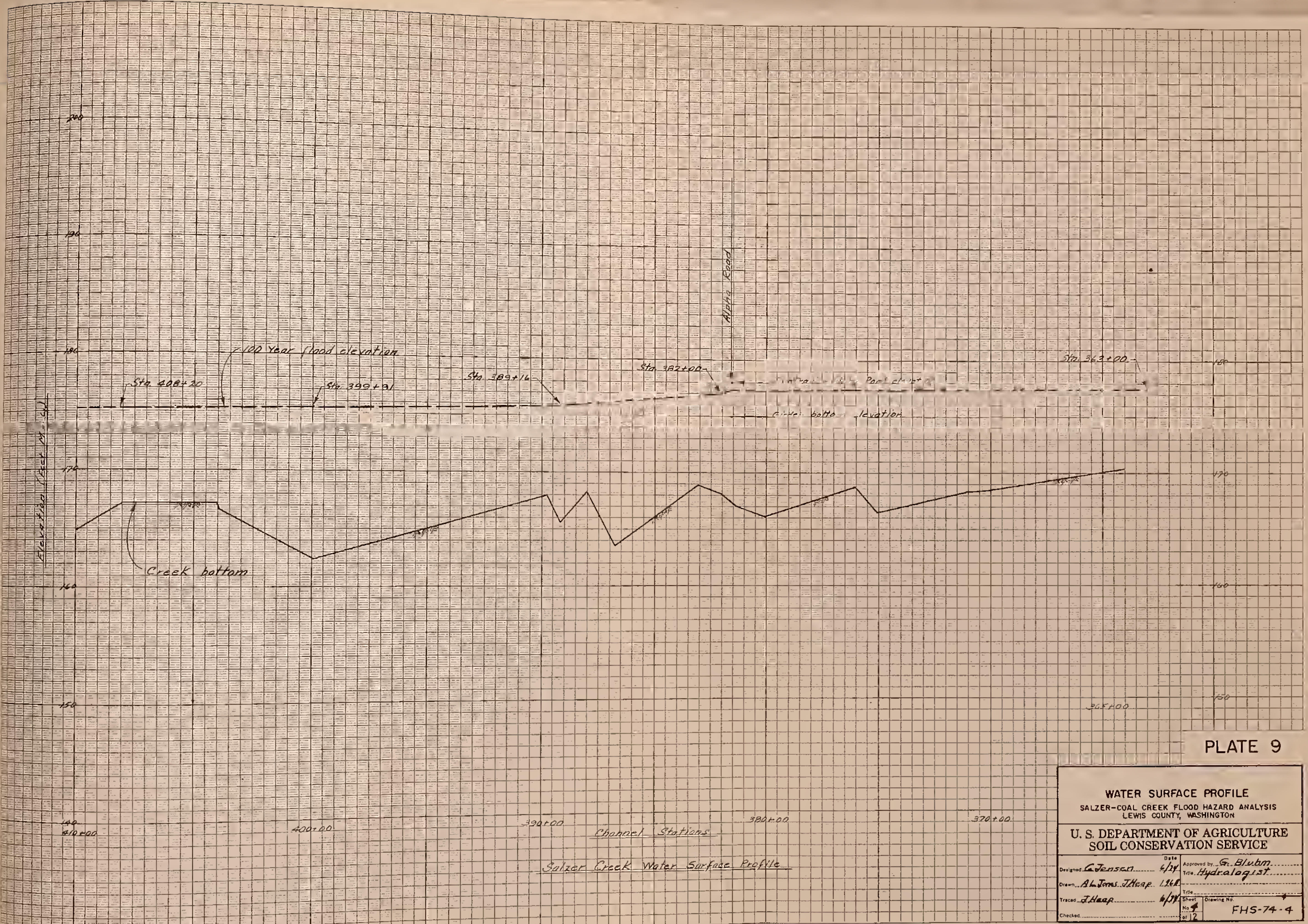


PLATE 9

WATER SURFACE PROFILE

SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen	6/74	Approved by G. Blubm	
Drawn A.L. Jones J.Heap		Title Hydrologist	
Traced J.Heap	6/74	Sheet No. 4 of 12	Drawing No. FHS-74-4
Checked			

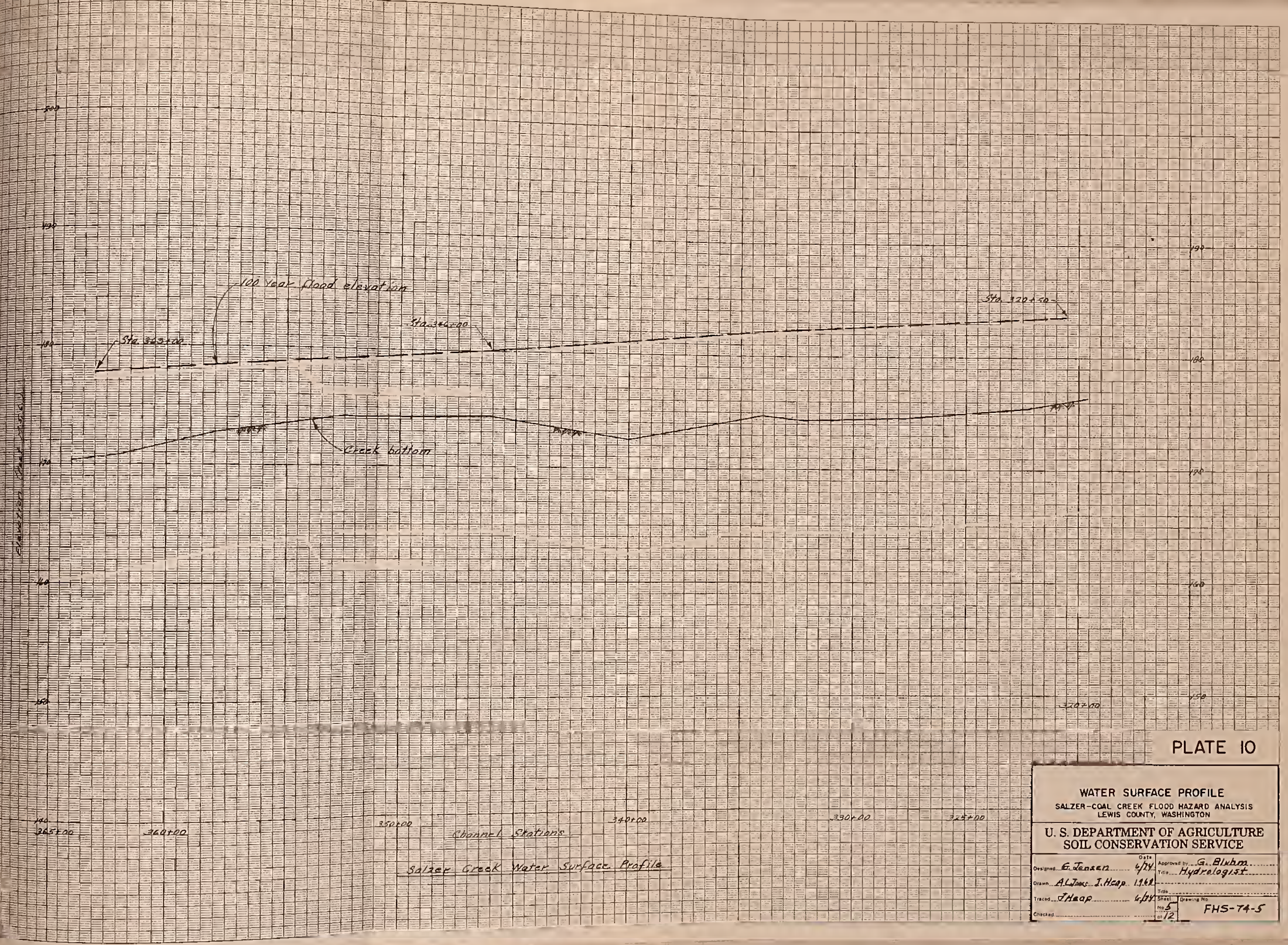


PLATE 10

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen 6/74
Drawn Al Jones I. Heap 1968
Traced J Heap 6/74
Checked
Approved by G. Bluhm
Title Hydrologist
Sheet No 5 of 12
Drawing No FHS-74-5

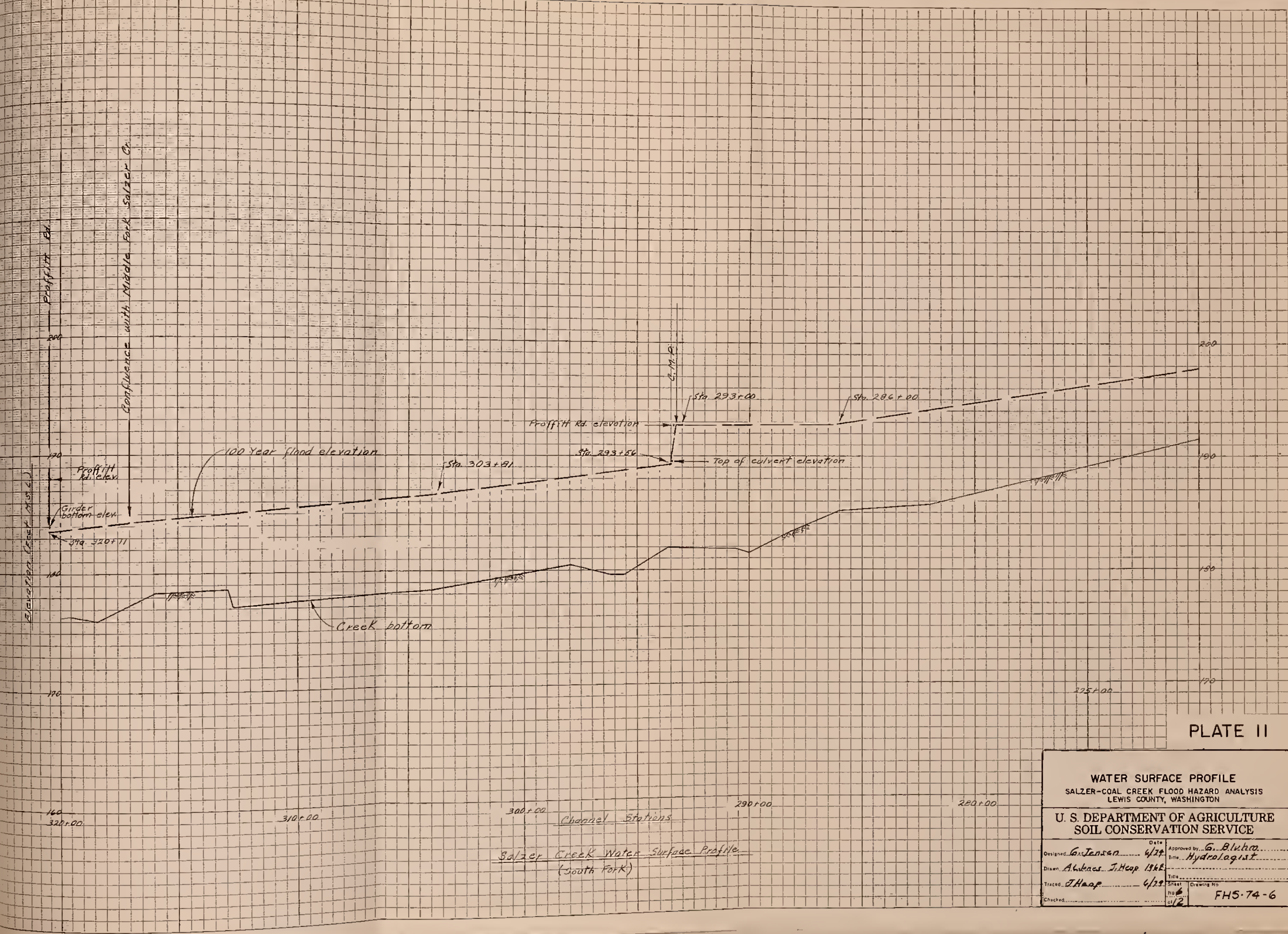


PLATE II

WATER SURFACE PROFILE

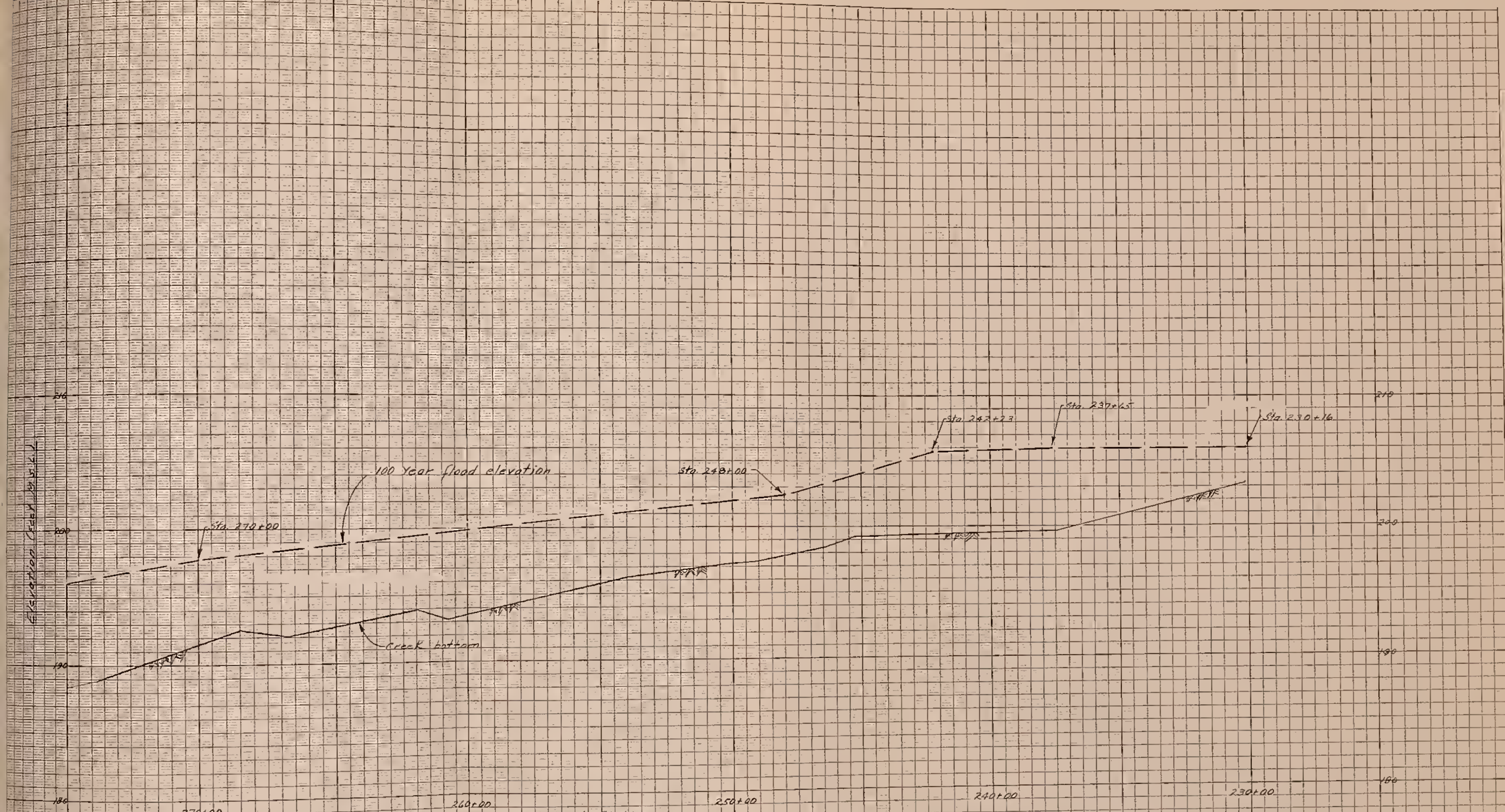
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen Date 6/74
Drawn A. Lucas J. Heap 1968
Traced J. Heap 6/74
Checked

Approved by G. Bluhm
Title Hydrologist
Title

Sheet No. 6 of 12
Drawing No. FHS-74-6



Channel Stations

Salzer Creek Water Surface Profile
(South Fork)

PLATE 12

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jansen	Date 6/74	Approved by G. Bluhm; Title Hydrologist
Drawn A.L Jones J.Heap	1968	Title
Traced J.Heap	6/74	Sheet No 7 of 12; Drawing No FHS-74-7
Checked		

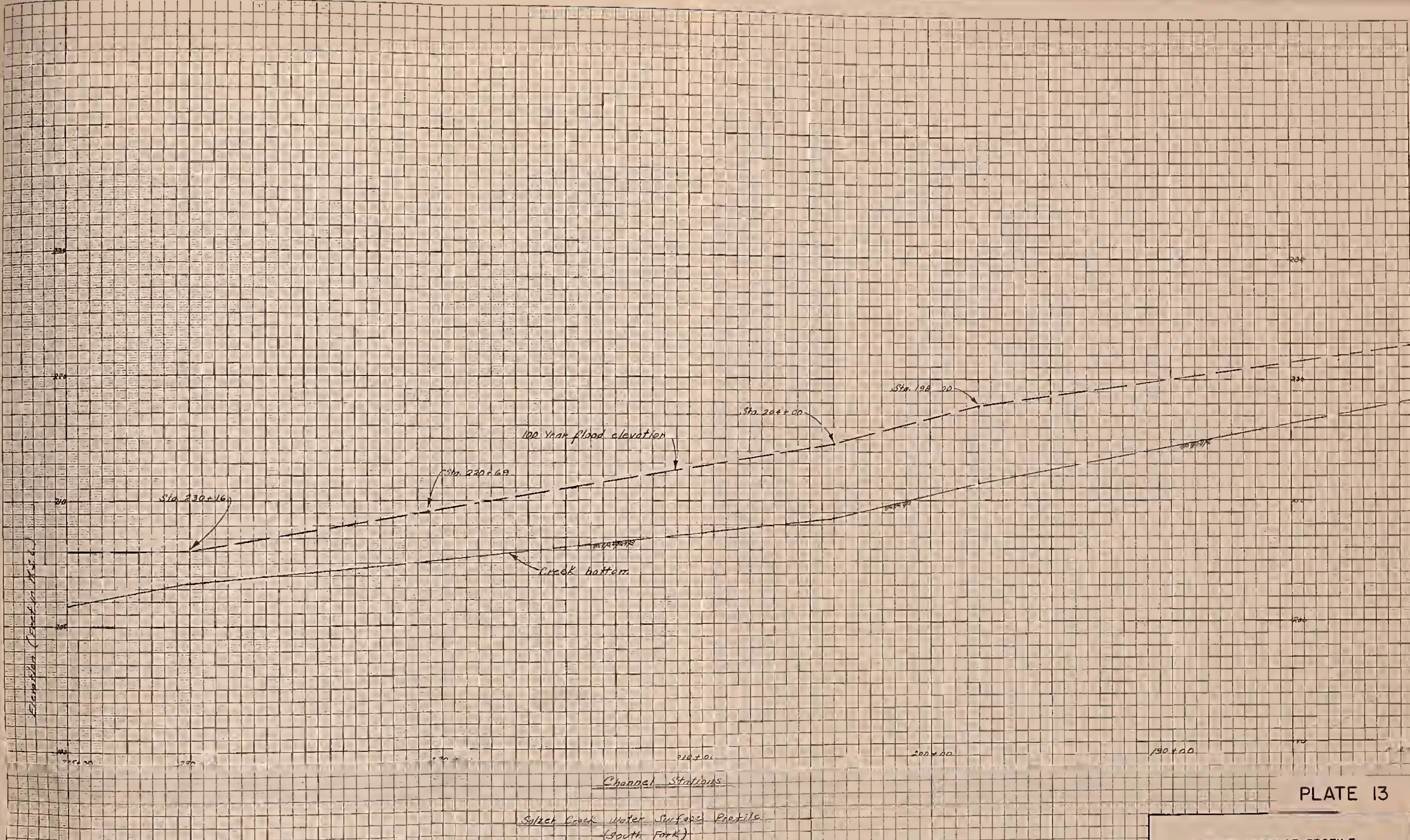
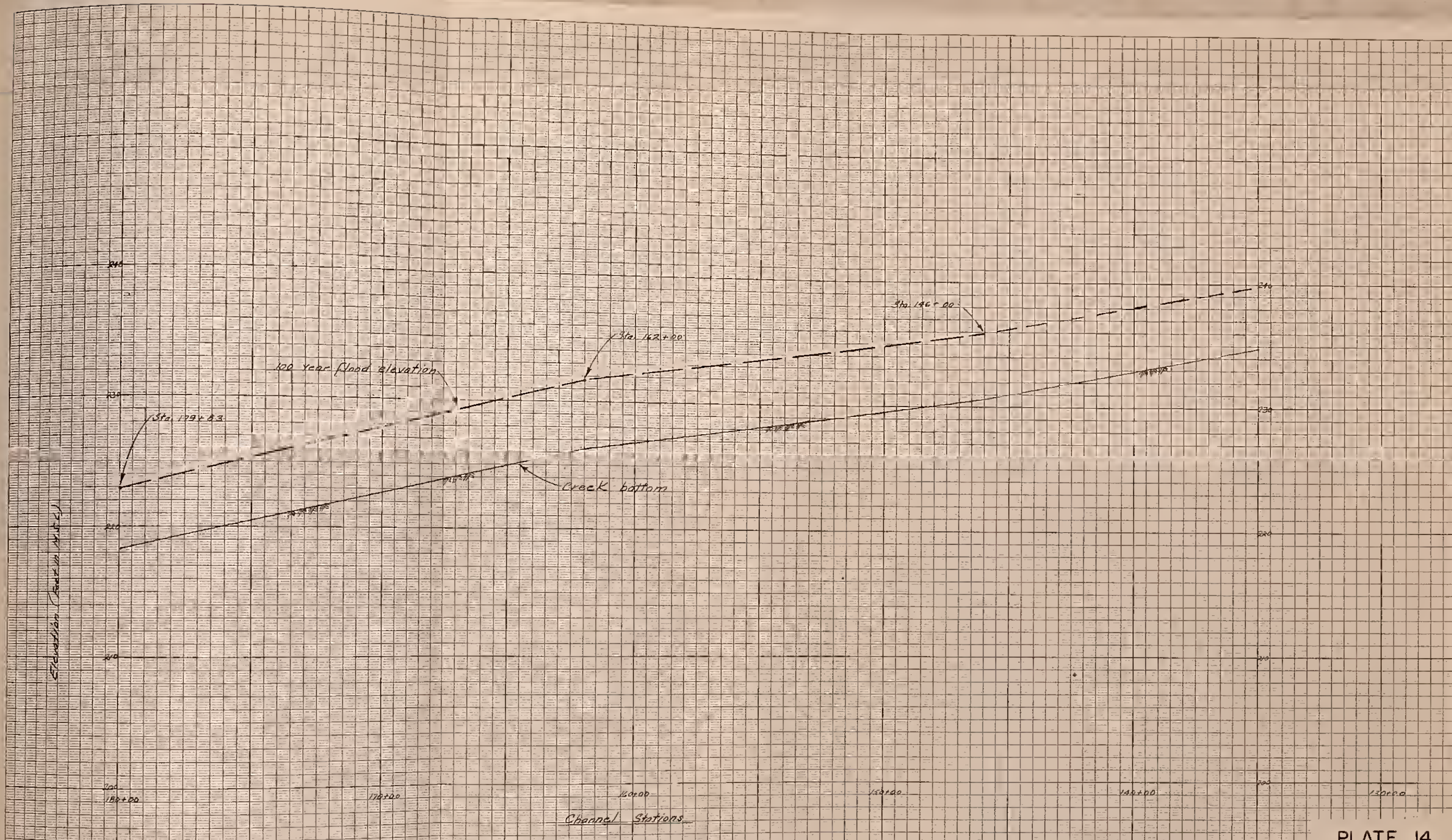


PLATE 13

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen	6/74	Approved by G. Bluhm	
Drawn A. Jones J. Heap	1968	Title Hydrologist	
Traced J. Heap	6/74	Sheet No. 8 of 12	Drawing No. FHS-74-8
Checked			



Salzer Creek Water Surface Profile
(South Fork)

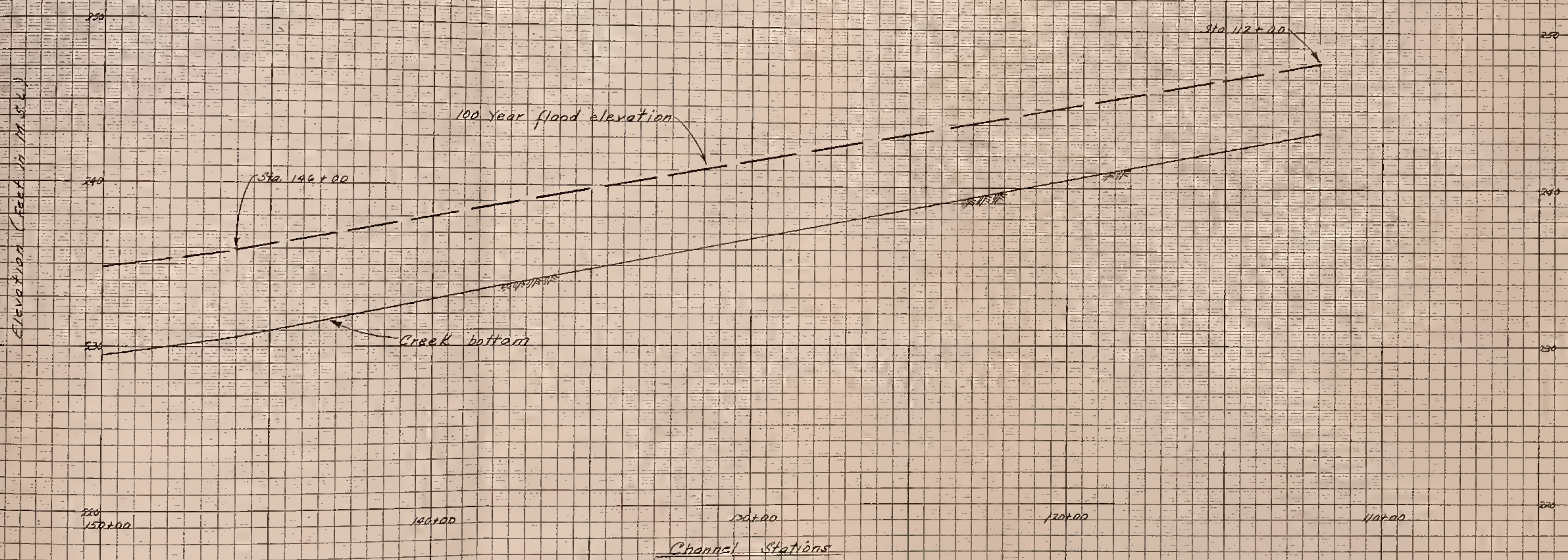
PLATE 14

WATER SURFACE PROFILE

SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen	Date 6/74	Approved by G. Bluhm	
Drawn D. Jones J. Heap	1968	Title Hydrologist	
Traced J. Heap	6/74	Sheet No. 9 of 12	Drawing No. FHS-74-9
Checked			



Salzer Creek Water Surface Profile
(South Fork)

PLATE 15

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen	Date
Drawn A. Jones J. Heap	Approved by G. Bluhm
Traced J. Heap	Title Hydrologist
Checked	Title
Sheet No 10 of 12	Drawing No FHS-74-10

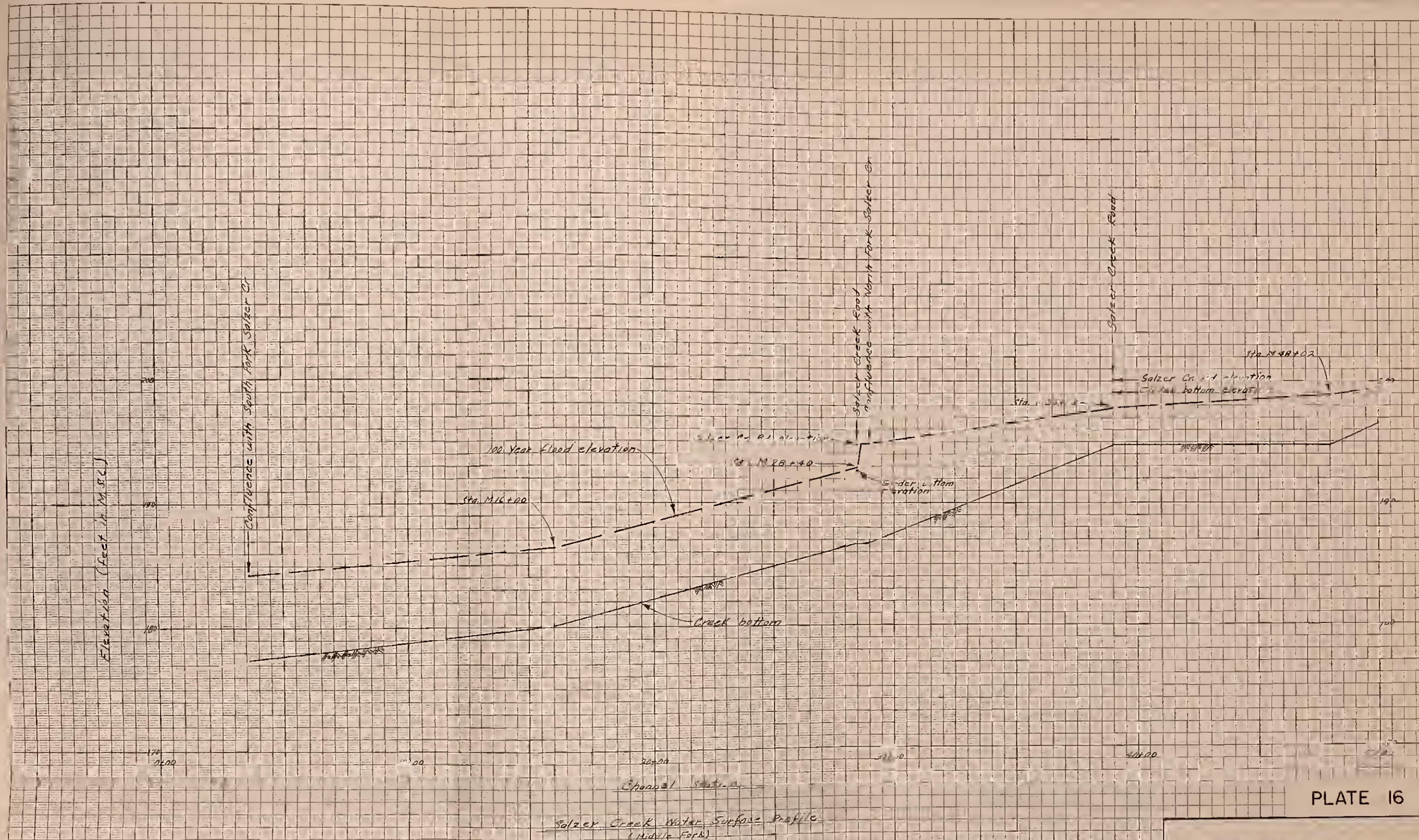
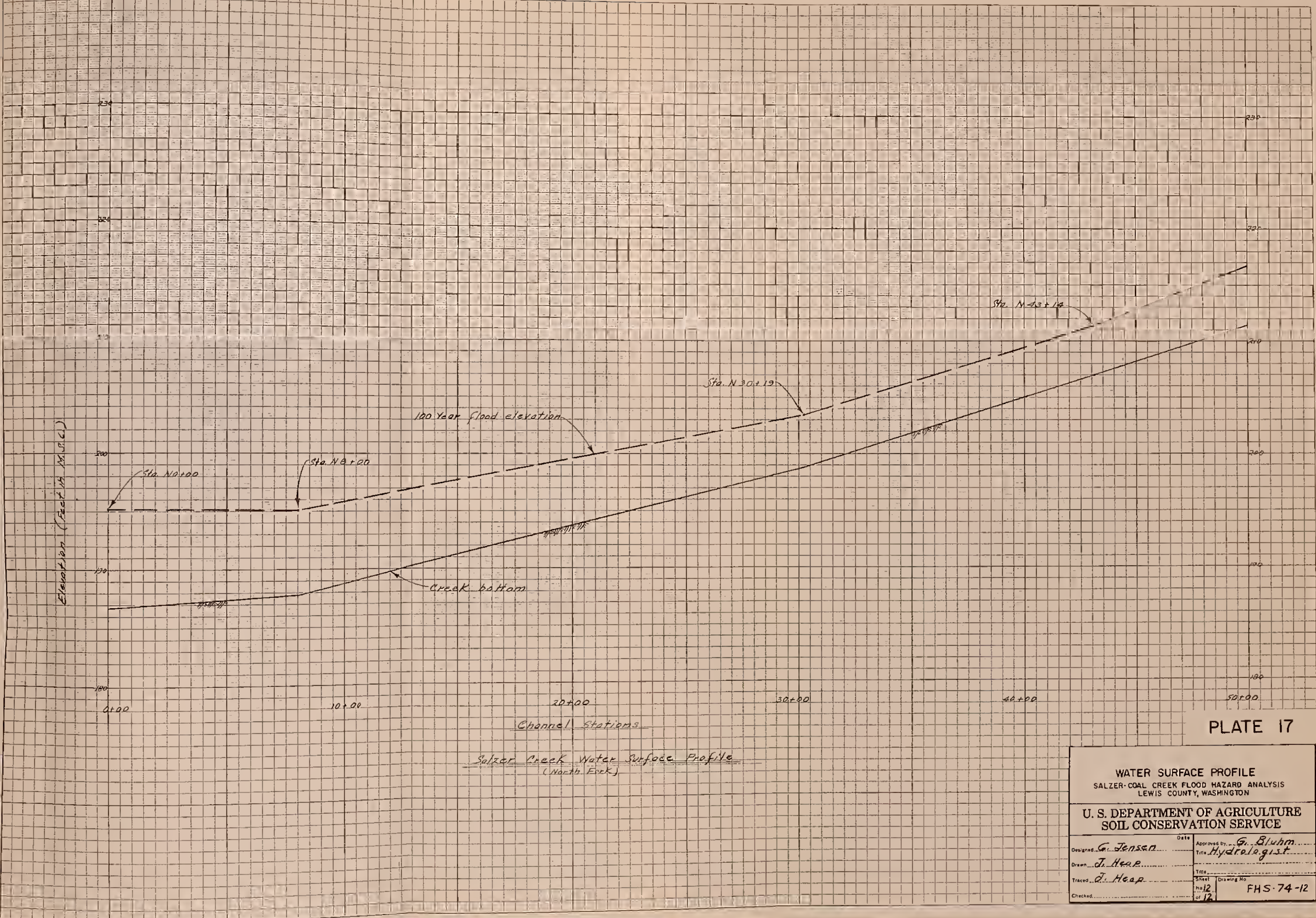


PLATE 16

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen	Date
Drawn J. Heap	Approved by G. Bluhm
Traced J. Heap	Title Hydrologist
Checked	Title
Sheet No 11 of	Drawing No FHS 74-11



Salzer Creek Water Surface Profile
(North Fork)

PLATE 17

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen
Drawn J. Heap
Traced J. Heap
Checked
Approved by G. Bluhm
Title Hydrologist
Sheet No. 12 of 12
Drawing No. FHS-74-12

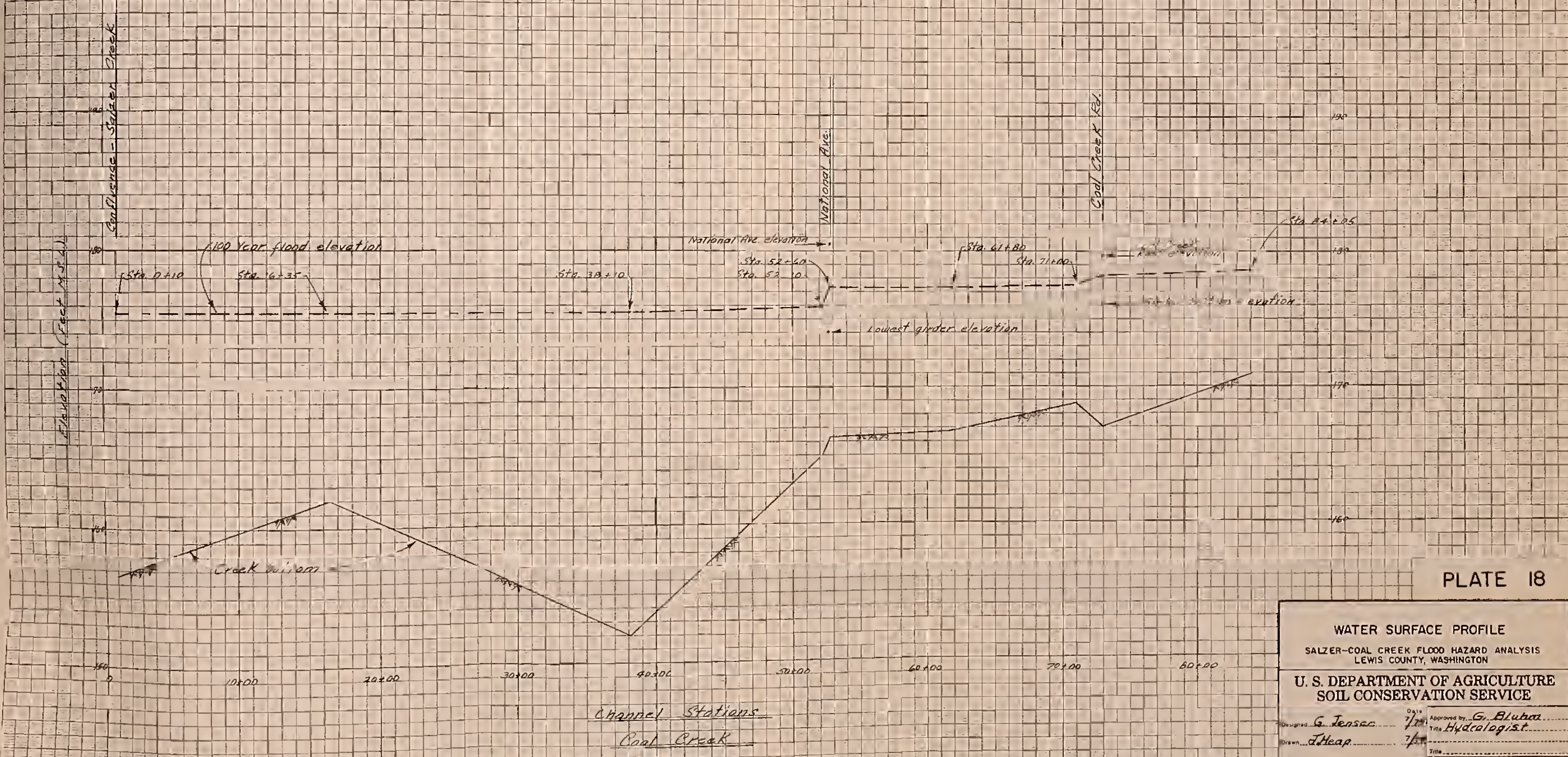


PLATE 18

WATER SURFACE PROFILE

SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen Date 7/74	Approved by G. Bluhm
Drawn J. Heap 7/74	Title Hydrologist
Traced	Title
Checked	Sheet No 1 of 3 — Drawing No FHS-74-13

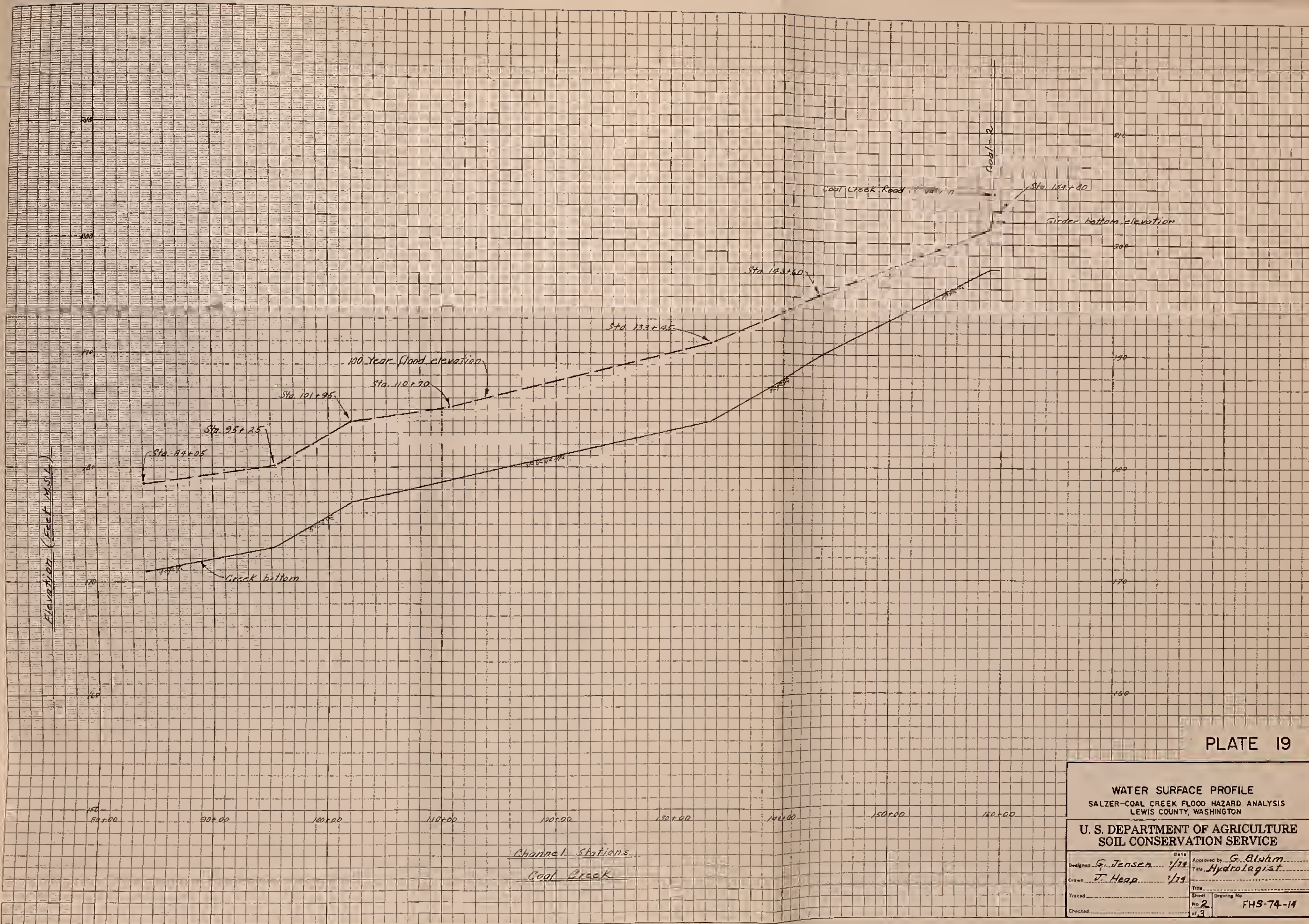


PLATE 19
Sta. 84+05
Sta. 95+25
Sta. 101+95
Sta. 110+70
100 Year flood elevation
Sta. 133+95
Sta. 143+40
Sta. 159+80
Girder bottom elevation
Creek bottom
Elevation (Feet M.S.L.)
80+00
90+00
100+00
110+00
120+00
130+00
140+00
150+00
160+00
170
180
190
Channel Stations
Coal Creek
WATER SURFACE PROFILE
SALZER–COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed G. Jensen 7/74
Drawn J. Heap 1/74
Traced
Checked
Approved by G. Bluhm
Title Hydrologist
Sheet No. 2 of 3
Drawing No. FHS-74-14

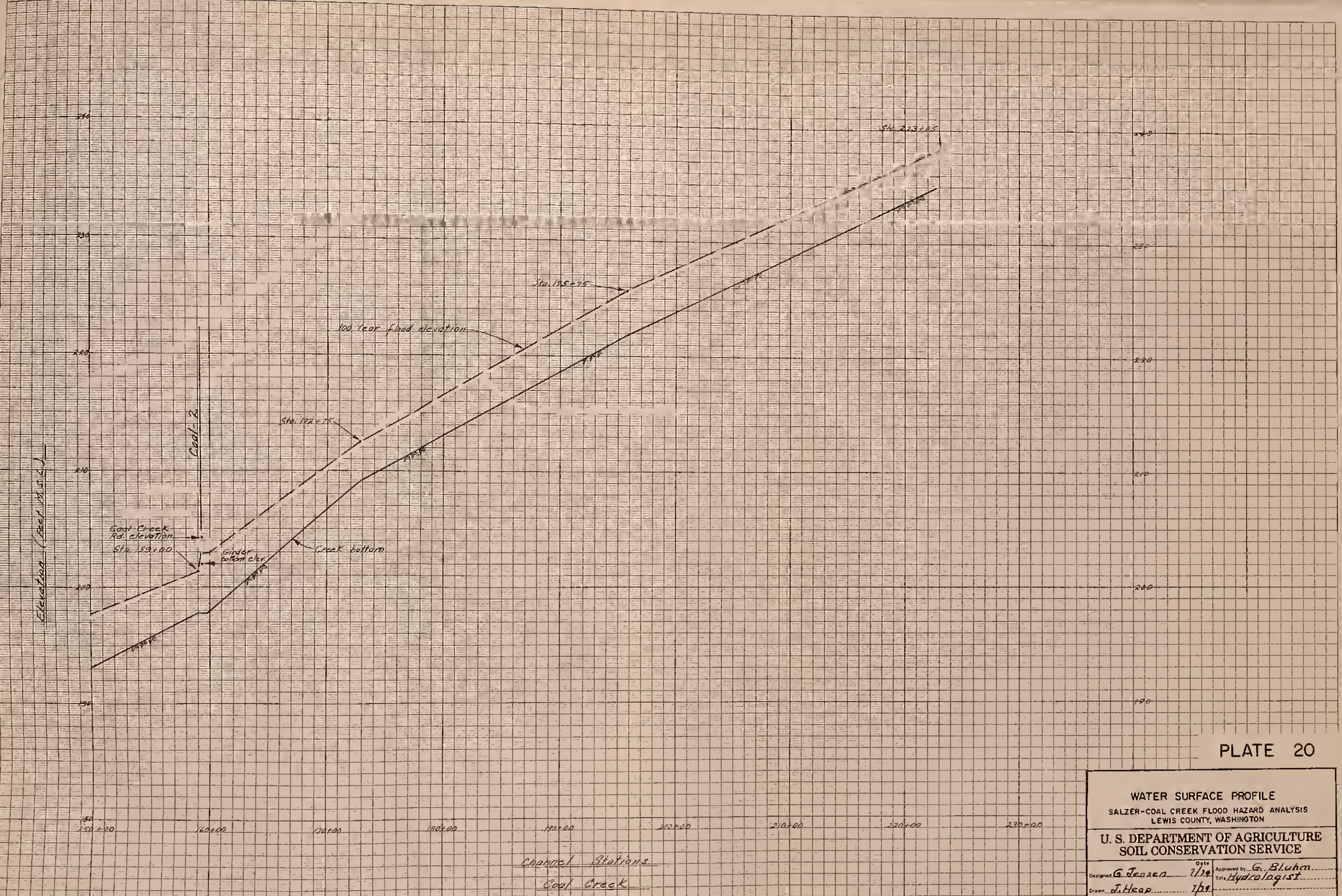


PLATE 20

WATER SURFACE PROFILE
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jenzen	Date 7/74	Approved by G. Bluhm	Title Hydrologist
Drawn J. Heap	7/74	Title	
Traced J. Heap	7/74	Sheet No. 3 of 3	Drawing No. FHS-74-15
Checked			

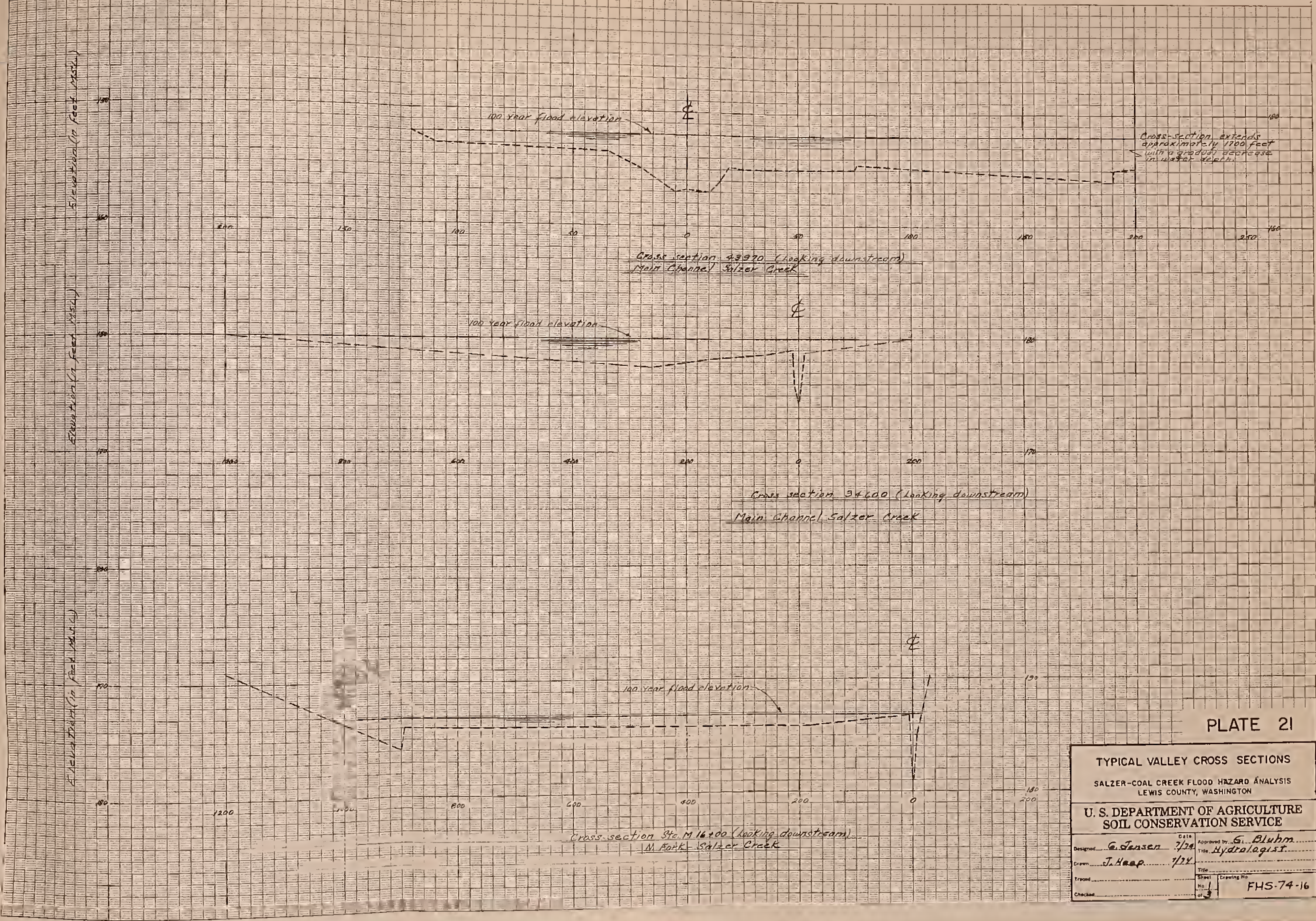


PLATE 21

TYPICAL VALLEY CROSS SECTIONS

SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen	Date 7/74	Approved by G. Bluhm	Title Hydrologist
Drawn J. Heap	7/74	Title	
Traced		Sheet No. 1 of 3	Drawing No. FHS-74-16
Checked			

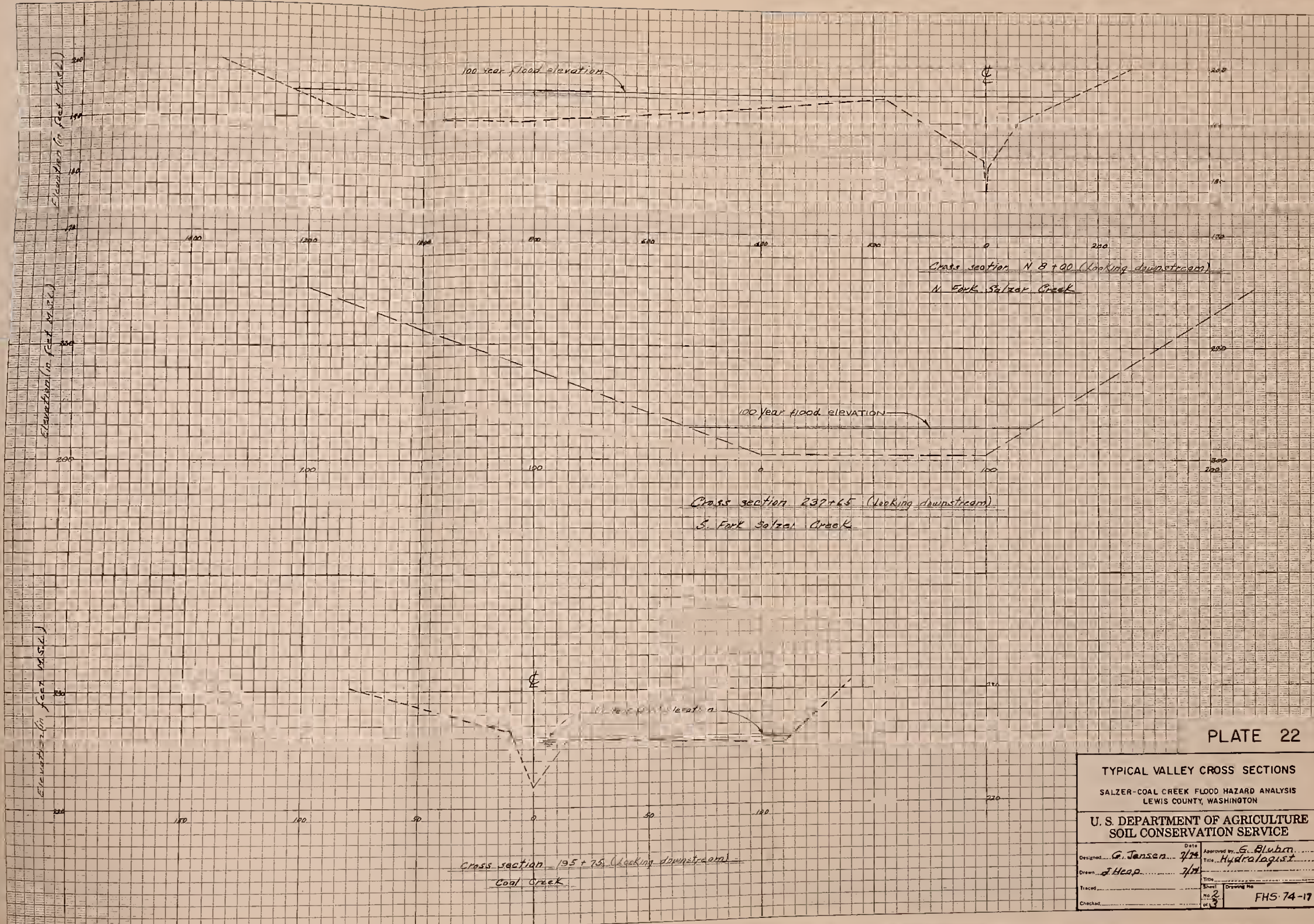


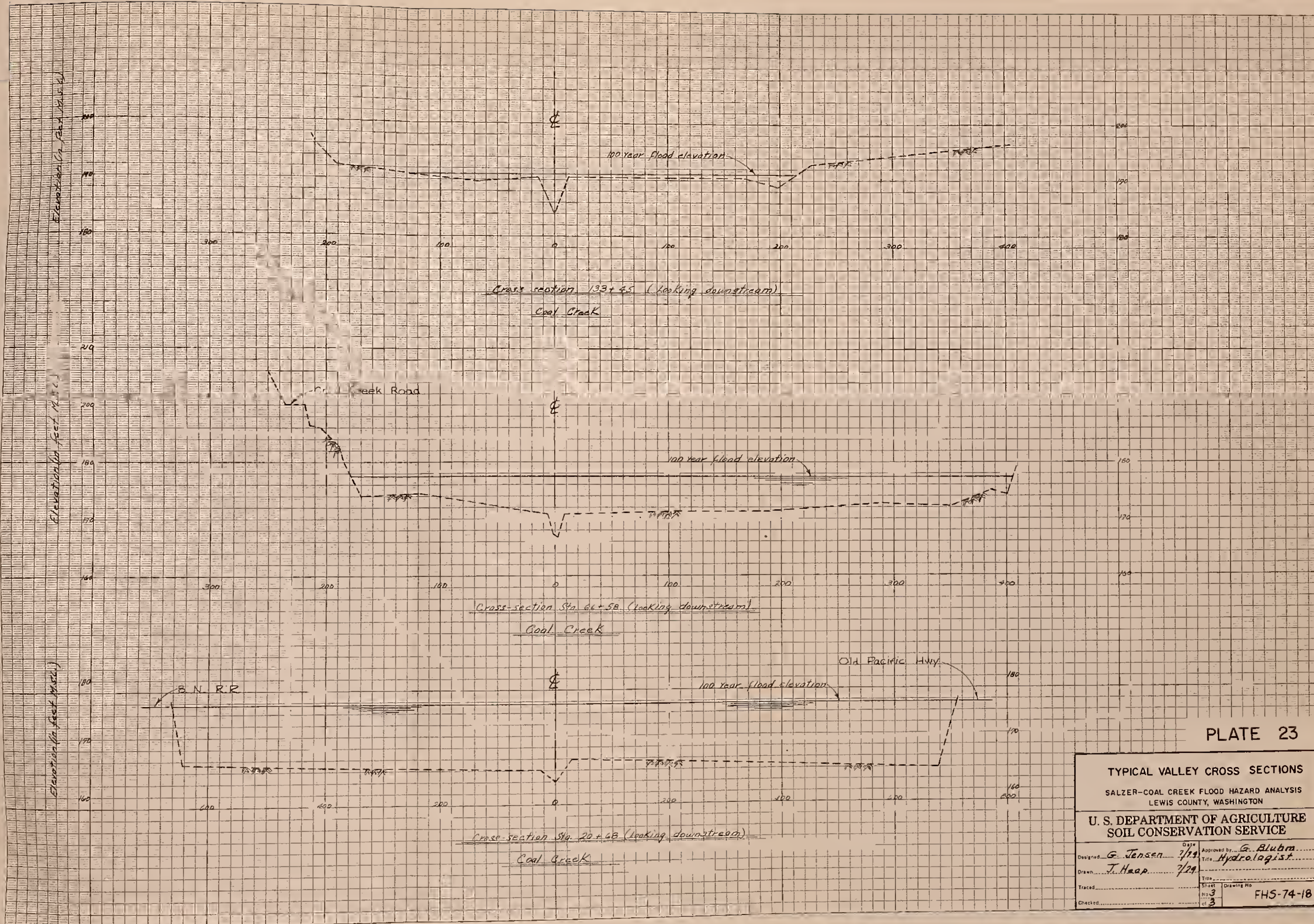
PLATE 22

TYPICAL VALLEY CROSS SECTIONS

SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G. Jensen 7/74 Approved by G. Bluhm
Title Hydrologist
Drawn J. Heap 7/74
Traced
Checked
Sheet No. 2 of 3 Drawing No. FHS-74-17



Elevation (in feet M.S.L.)
100 Year flood elevation
Cross section 133+45 (Looking downstream)
Coal Creek
Coal Creek Road
100 Year flood elevation
Cross-section Sta. 66+58 (Looking downstream)
Coal Creek
B.N. R.R.
Old Pacific Hwy
100 Year flood elevation
Cross-section Sta. 20+68 (Looking downstream)
Coal Creek
PLATE 23
TYPICAL VALLEY CROSS SECTIONS
SALZER-COAL CREEK FLOOD HAZARD ANALYSIS
LEWIS COUNTY, WASHINGTON
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed G. Jensen 7/79
Drawn J. Heap 7/79
Approved by G. Bluhm
Title Hydrologist
Sheet No. 3 of 3
Drawing No. FHS-74-18

TABLE 3

MINIMUM ALLOWABLE FLOODWAY WIDTHS FOR ENCROACHMENT AND THE RESULTING VELOCITIES

Station	Left (in feet)	Right (in feet)	Average Floodway Velocity (in ft./sec.)
	SALZER CREEK		
521+30	200	200	.9
520+50	200	200	.9
Freeway			
518+50	200	200	.9
518+00	200	200	.9
516+50	200	200	.9
514+53	240	320	.6
501+50	350	0	1.1
488+00	350	0	1.1
National Avenue			
487+00	340	410	.5
476+00	130	290	1.2
Bus station			
475+00	120	260	.8
471+00	280	420	.7
Grand Avenue			
470+00	200	-	1.5
460+00	110	80	2.9
454+00	200	10	2.0
439+70	0	200	2.3
Pacific Avenue			
439+25	20	230	1.8
432+00	70	960	.9
425+40	50	790	.9
Alvord Road			
425+00	60	760	1.3
420+50	210	640	.9
408+20	40	660	1.2
399+91	190	370	1.6
389+16	300	160	2.2
382+00	20	50	3.8
Centralia Alpha Road			
381+71	160	110	.9
363+00	370	140	.8

TABLE 3 (continued)

Station	Left (in feet)	Right (in feet)	Average Floodway Velocity (in ft./sec.)
	SALZER CREEK (continued)		
346+00	250	0	3.1
334+00	185	75	2.8
320+50	20	0	2.4
Proffitt Road			
320+11	0	0	3.2
Proffitt Road			
	SOUTH FORK SALZER CREEK		
293+00	0	250	.6
286+00	130	0	.9
248+00	0	0	2.4
237+65	0	0	.7
230+16	345	0	.1
220+69	0	90	2.3
204+00	0	0	.5
179+83	0	0	4.3
162+00	0	0	4.0
112+00	0	0	3.1
	MIDDLE FORK SALZER CREEK		
M 16+00	0	0	3.8
M 39+00	0	0	3.1
M 48+00	0	0	2.9
	NORTH FORK SALZER CREEK		
N 8+00	890	40	1.0
N 30+20	0	10	3.5
N 43+14	0	150	3.3

TABLE 3 (continued)

Station	Left (in feet)	Right (in feet)	Average Floodway Velocity (in ft./sec.)
	COAL CREEK		
16+35	80	80	.4
38+10	80	80	.4
52+10	110	10	5.4
National Avenue			
53+10	30	330	.9
61+80	80	260	.8
71+00	50	80	1.9
Coal Creek Road			
71+80	20	15	2.6
84+05	0	0	1.6
95+25	110	0	2.8
101+95	0	0	5.2
110+70	0	0	2.5
159+00	0	0	3.3
Coal Creek Road			
159+80	40	0	1.5
172+75	70	0	2.9
223+05	0	0	2.8

NOTE: This table shows the maximum allowable encroachment (i.e., minimum flood plain widths). This encroachment will produce a 1.0 foot increase in the 100-year water surface elevation at the cross section station. Any further reduction of floodway widths will increase the elevation of the water surface more than 1.0 foot. The reduction in floodway width is based on equal reduction in flood conveyance factors on both sides of the channel, where possible. Distances to the left and right are measured from the respective edges of the main channel looking downstream.

TABLE 4

FLOOD FREQUENCY DISCHARGE FOR SELECTED CROSS SECTIONS

WITH FUTURE LAND USE

Estimated Peak Discharges for Selected Frequency Floods

Cross Section Station	50-Year CFS	100-Year CFS	500-Year CFS
	SALZER CREEK		
536+99	1,215	1,510	2,170
475+00	950	1,180	1,700
420+50	870	1,080	1,550
363+00	800	1,000	1,440
320+11	760	950	1,360
	SOUTH FORK SALZER CREEK		
293+56	515	642	920
286+00	505	629	900
237+65	472	587	850
179+83	365	455	655
112+00	316	393	565
	MIDDLE FORK SALZER CREEK		
M 16+00	390	490	700
M 39+00	160	200	280
M 56+68	130	165	235
	NORTH FORK SALZER CREEK		
N 8+00	365	455	655
N 43+14	350	440	630
	COAL CREEK		
0+10	480	590	850
53+10	420	520	750
71+80	390	490	710
110+70	360	450	640
143+60	350	435	630
159+80	250	315	450
195+75	140	175	250
223+05	60	70	110

TABLE 5

ELEVATIONS OF VARIOUS FREQUENCY FLOODS

WITH FUTURE LAND USE

Channel Station	Streambed	50-Year Flood	100-Year Flood	500-Year Flood
	----------Elevation in Mean Sea Level------------			
	SALZER CREEK			
536+99	146.9	173.0	175.5	179.6
488+00	157.2	173.3	175.7	179.7
Bus Sta				
475+00	158.8	173.7	175.8	179.8
454+00	162.5	174.0	176.0	179.9
Pacific Avenue				
439+25	166.5	175.0	176.2	180.0
425+40	163.9	175.1	176.3	180.0
Alvord Road				
420+50	164.2	175.2	176.3	180.0
382+00	168.0	176.9	177.5	180.2
Centralia Alpha Road				
363+00	170.3	177.4	178.0	180.3
346+00	174.3	179.9	180.1	181.1
320+50	175.6	183.5	183.8	184.5
Proffitt Road				
320+11	176.3	183.6	185.4	186.1
	SOUTH FORK			
293+56	181.9	188.9	189.3	190.0
293+00	181.9	192.7	192.8	192.9
286+00	185.1	192.8	193.0	193.2
248+00	197.7	202.5	203.0	203.7
237+65	199.6	206.3	206.7	207.8
220+69	205.1	209.3	209.5	210.0
204+00	208.5	214.8	214.9	215.4
179+83	218.3	223.1	223.2	223.7
162+00	226.3	232.1	232.3	232.9
112+00	243.6	248.2	248.6	249.3
	MIDDLE FORK SALZER			
M 16+00	180.1	186.5	186.9	187.8
M 28+90	186.7	192.6	193.1	193.4
M 39+02	194.7	197.8	198.2	198.8
M 48+02	194.7	198.0	198.9	199.0

TABLE 5 (cont.)

ELEVATIONS OF VARIOUS FREQUENCY FLOODS

WITH FUTURE LAND USE

Channel Station	Streambed	50-Year Flood	100-Year Flood	500-Year Flood
	------------Elevation in Mean Sea Level------------			
		NORTH FORK SALZER		
N 8+00	177.8	194.8	194.9	195.0
N 30+19	198.8	203.4	203.5	203.8
N 43+14	207.0	210.7	211.3	212.2
		COAL CREEK		
0+10	156.6	173.2	175.5	179.6
52+10	165.0	174.2	176.0	179.7
National Avenue				
53+10	166.3	176.0	177.8	180.8
71+00	168.6	176.4	177.9	180.9
Coal Creek Road				
71+80	168.6	177.5	178.9	180.9
95+25	173.0	180.0	180.5	181.6
110+70	178.8	185.0	185.4	185.8
143+60	189.8	195.0	195.4	195.9
159+00	197.7	201.1	201.4	202.0
Coal Creek Road				
159+80	197.7	202.6	203.0	204.4
195+75	221.8	225.6	225.9	226.4
223+05	235.1	238.2	238.5	238.9